PAM & SAM System User's Manual

Part 2 - System Design and Integration

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This version replaces all previous versions of this document. It also replaces the SAM System Designer's Guide (1995-1996). Inmotion Technologies and ACC Motion have made every effort to insure this document is complete and accurate at the time of printing. In accordance with our policy of continuing product improvement, all data in this document is subject to change or correction without prior notice.

ACC Motion SA
Zone industrielle La Rippe
CH-1303 Penthaz
Switzerland

P/n 9032 011 982
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Grounding and Shielding

About Protective Earth and Functional Earth Grounds

Protective Earth Ground

Protective earth ground is primarily a safety function. Physically, a protective earth ground is a wire connected on one end to some points in a circuit or to the exterior metal surfaces of devices. The other end is connected to the earth. In the event that a short circuit occurs within the device, current flows in the protective earth ground, preventing the voltage at the grounded point from reaching a dangerous level with respect to the earth.

In this manual, one or both of the following symbols indicate protective earth ground connections:

Figure 1 Symbols for Protective Earth Ground

EMC practices and safety requirements have common aspects such as earthing (grounding), over-voltage protection and lightning protection. Occasionally, the two may seem to conflict. In such cases, safety requirements must always have precedence over EMC practices and alternate EMC measures must be sought.

Functional Earth Ground

Functional earth grounds serve primarily to neutralize the electrical charge that develops in the shields and metal cases enclosing system components. The currents flowing in functional earth grounds are high frequency; therefore, conductors with a large surface area such as flat braided cable must be used for making high quality, low impedance functional earth ground connections.

In this manual, functional earth ground connections are indicated by the following symbol:

Figure 2 Symbol for Functional Earth Ground

Functional earth grounding is not simply connecting a wire to ground. Since perturbations are high frequency, current flow is concentrated at the outside surface of the conductor. Therefore, to have a good functional earth ground connection, a conductor with a large surface area (such as flat braided cable) must be used.

Protective Earth Grounding Requirements

General

This section describes the protective earth (PE) grounding requirements for a PAM with SAM system. Local, national and international regulations may specify additional PE grounding requirements. These regulations also specify other aspects of protective earth grounds including conductor cross-section and color, connection means at the device and manner of connecting to the earth. PAM with SAM system users must be aware of and comply with any additional PE grounding requirements.

AC Supply with Grounded Neutral

Operating a PAM with SAM system from an ungrounded AC Supply is prohibited.

AC Supply system grounding is a crucial consideration. The AC Supply **must** have a grounded neutral (see Figure 3).

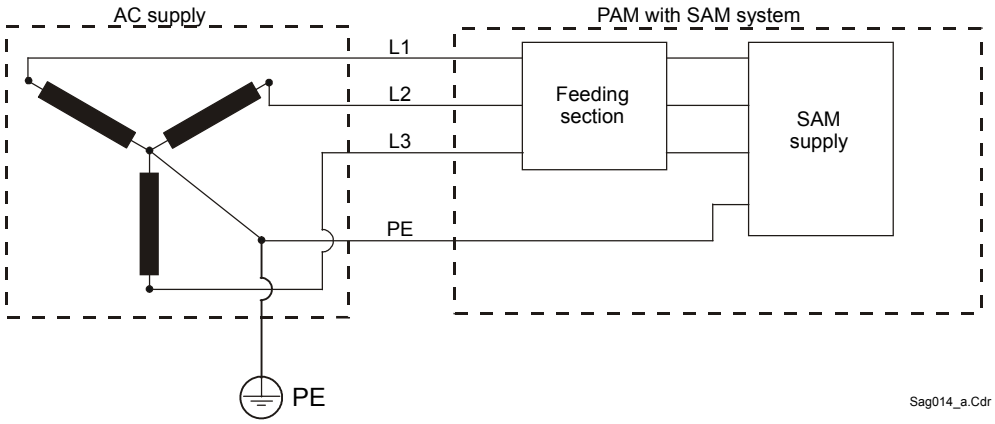


Figure 3 AC Supply with a Grounded Neutral

If a three phase, 4 wire, grounded neutral AC Supply is not available, an isolation transformer with “Wye” connected secondary must be used (see Figure 46). The secondary neutral (star point) must be solidly connected to protective earth ground in accordance with applicable regulations.

For additional information on AC Supply grounding, refer to IEC 664-1: 1992-10, Table B2 “Three phase, four wire systems with earthed neutral”

System, Cabinet and Machine

1. All SAM Drives and SAM Supplies must be connected to PE ground using the designated PE terminal on each unit (see Figure 4).
2. The 24 VDC supply (negative side) must be connected to PE ground.
3. The PE conductor in each motor winding cable must be connected to PE ground in the cabinet and to a PE grounding screw at the motor.

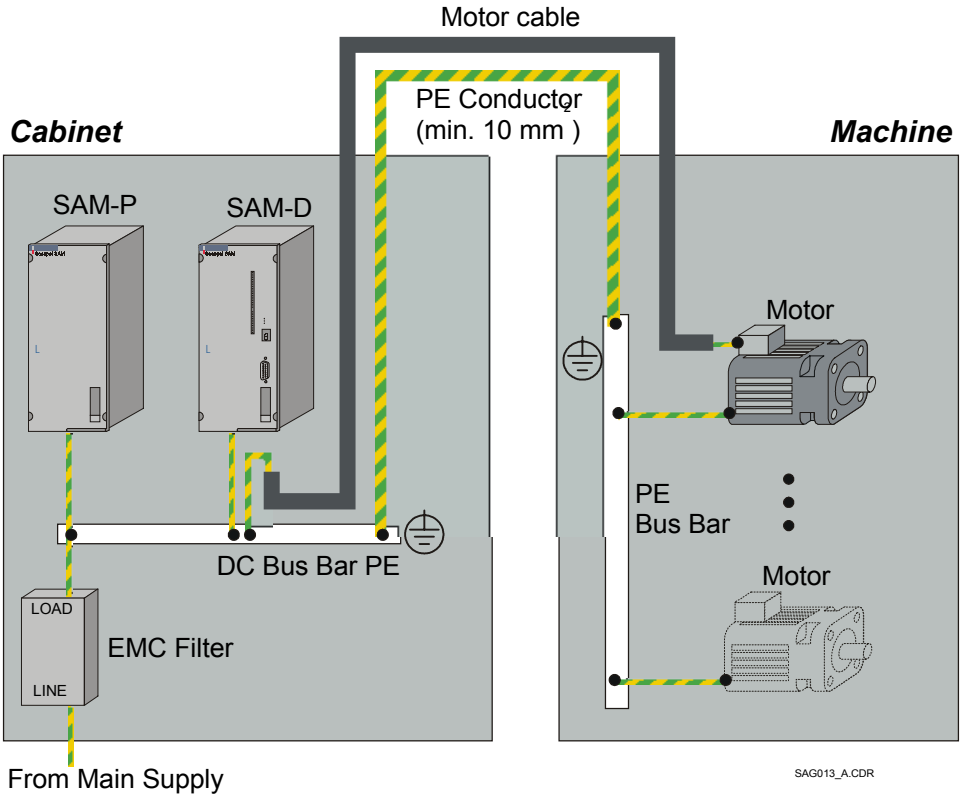


Figure 4 Machine to System Enclosure PE Conductor

Grounding for Electro-magnetic Compatibility

Electro-magnetic compatibility (EMC) is the capability of a part of a system to work without perturbing (emission) - and being perturbed by (immunity) - the rest of the system with electromagnetic phenomena. There are a few basic rules.

4. The system cabinet must be designed for EMI/RFI attenuation.
5. The backpanel (equipment mounting panel) must be bare (unpainted). The areas beneath where the PAM, SAM Drives, SAM Supplies and EMI filters are mounted, provide intimate metallic contact between the units and backpanel. When using Aluminum backpanel, avoid surface oxidation treatments.
6. The back panel must be connected to functional earth ground with a high quality ground connection. Normally the best way to achieve this is with a large area of metal to metal contact between the back panel and the metal structure

of the cabinet. Otherwise, connect the back panel to functional earth ground using braided wire cable with large surface area.

7. The system cabinet and the machine on which the motors are mounted must be connected to the functional earth network of the building as illustrated in Figure 5. If this is not possible, metallic conduits and cable trays carrying motor and feedback cables may be utilized to create a meshed grounding network (see Figure 6).
8. Motor windings cables shields must be properly terminated and connected to functional earth ground (see "Interfacing AC Servomotors" on page 23). On the motor end, the motor windings cable shields are connected to the motor case and to the machine's functional earth ground. A large area of metal to metal contact between the motor and the machine structure is required.

Motor windings cable shields may carry strong, capacitively induced high frequency currents. These currents are normally routed to earth ground and therefore pose no danger. Should the user fail to connect a motor cable shield to earth ground, a voltage potentially dangerous to humans may be present at places that are not at least IP20 protected.

A mesh functional earth network throughout the machine and even throughout the building is recommended. Each room should have earthing network conductors to which the machine structures, enclosures, cable trays, etc. are bonded. Ground loops are not only allowed, they are an effective EFI/RFI mitigation measure.

Refer also to IEC 1000-5-2 “Installation and Mitigation Guidelines, Earthing and Cabling”. This technical report provides valuable information.

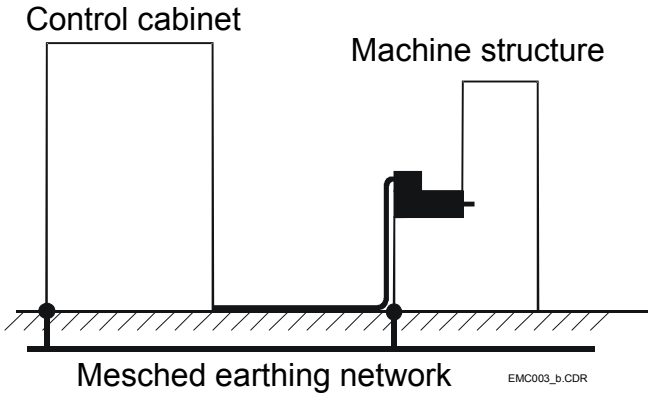


Figure 5 Mesh Earthing Network Using Building Structure

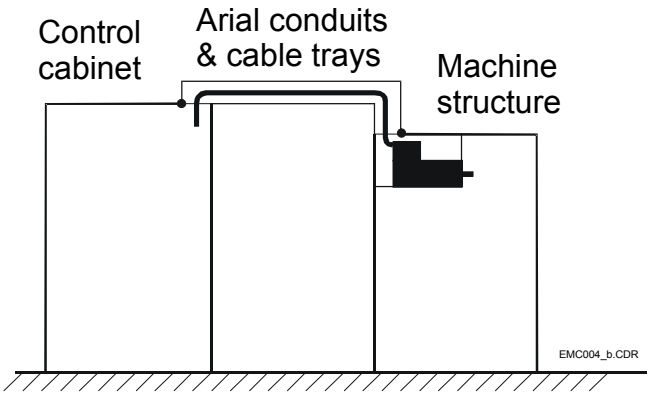


Figure 6 Mesh Earthing Network Using Conduits and Cable Trays

Enclosure Layout

Concept for an Entire Machine Control System

Figure 7 illustrates a general concept for an enclosure housing a complete machine control system where power and control as well as high frequency and low frequency parts of the system are located in separate areas of the enclosure. In addition, the cables carrying power, control, high frequency and low frequency should be separated in the same manner.

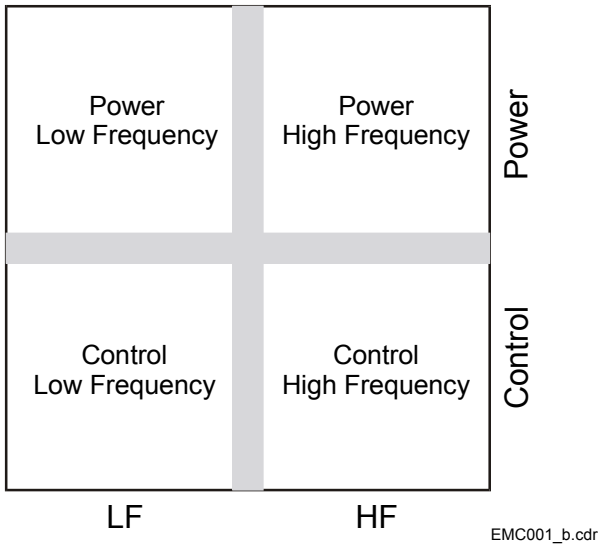


Figure 7 Enclosure Layout Concept

Rules for Enclosure Layout

The following are some general rules for enclosure layout:

1. Power and control devices as well as high and low frequency parts must be separated and placed in different areas which are a minimum of 30 cm apart (see Figure 7).
2. To be an effective ground plane, the back panel on which devices are mounted must **not** be painted (nor oxidized if Aluminum is used).
3. The contact area between all devices and the ground plane (back panel) must be as large as possible. When SAM Drives and SAM Supplies are mounted on the back panel, their cases become part of the ground plane.
4. Power cables must not cross the control area and control cables must not cross power area.
5. If not shielded, power and the control cables must be minimum of 30 cm apart. They must be as close as possible to the ground plane (back panel) in order to reduce the area of the loop they make with it.
6. Shields must be connected to the ground plane or directly to the device with 360° contact (using a cable gland and strain relief, for example). The shield must **not** be twisted in “pig tail” fashion and connected to a terminal.

7. Where possible, place devices that generate a large quantity of heat toward the top of the enclosure.

Recommended Layout for a PAM with SAM System

Figure 8 illustrates an implementation of the enclosure layout concept for a seven-axes PAM with SAM system. The mating connectors for the SAM Drive and SAM Supply are strategically located to simplify wiring and cable routing with this arrangement.

For large systems requiring more than one SAM Supply, the DC Bus output (and associated DC Bus distribution network) for each SAM Supply must remain electrically isolated from the DC Bus of all other SAM Supplies in the system.

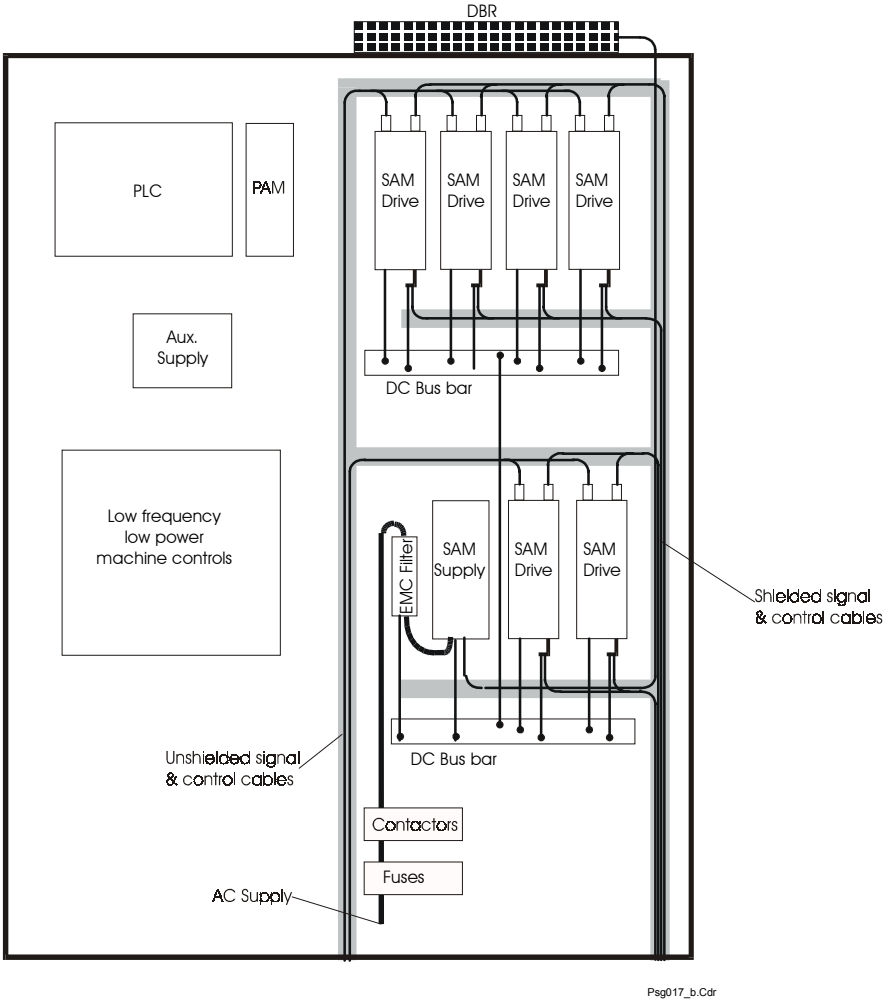


Figure 8 Enclosure Layout for a Large System

Rules for Placement of EMC Line Filter

When placing an EMC line filter in the enclosure, use the following guidelines:

1. Keep the length of wiring between filter and SAM Supply as short as possible.
2. The input (line side) of the EMC filter must be as close as possible to the point where the AC Supply cable enters the enclosure.
3. The EMC Line Filter relies on capacitance between AC Supply conductors and functional earth. Therefore, the EMC Line Filter must have metal to metal contact with the ground plane (back panel) over the largest possible area.

Back Panel Layout

Unit Mounting Dimensions and Spacing

Figure 9 illustrates the recommended horizontal and vertical spacing between SAM Drives/Supplies and adjacent units. The vertical dimensions in Figure 9 indicate the minimum clearance required for connecting/removing mating connectors (including cable bend radius). The 1.0-mm horizontal spacing accommodates normal tolerances in unit width.

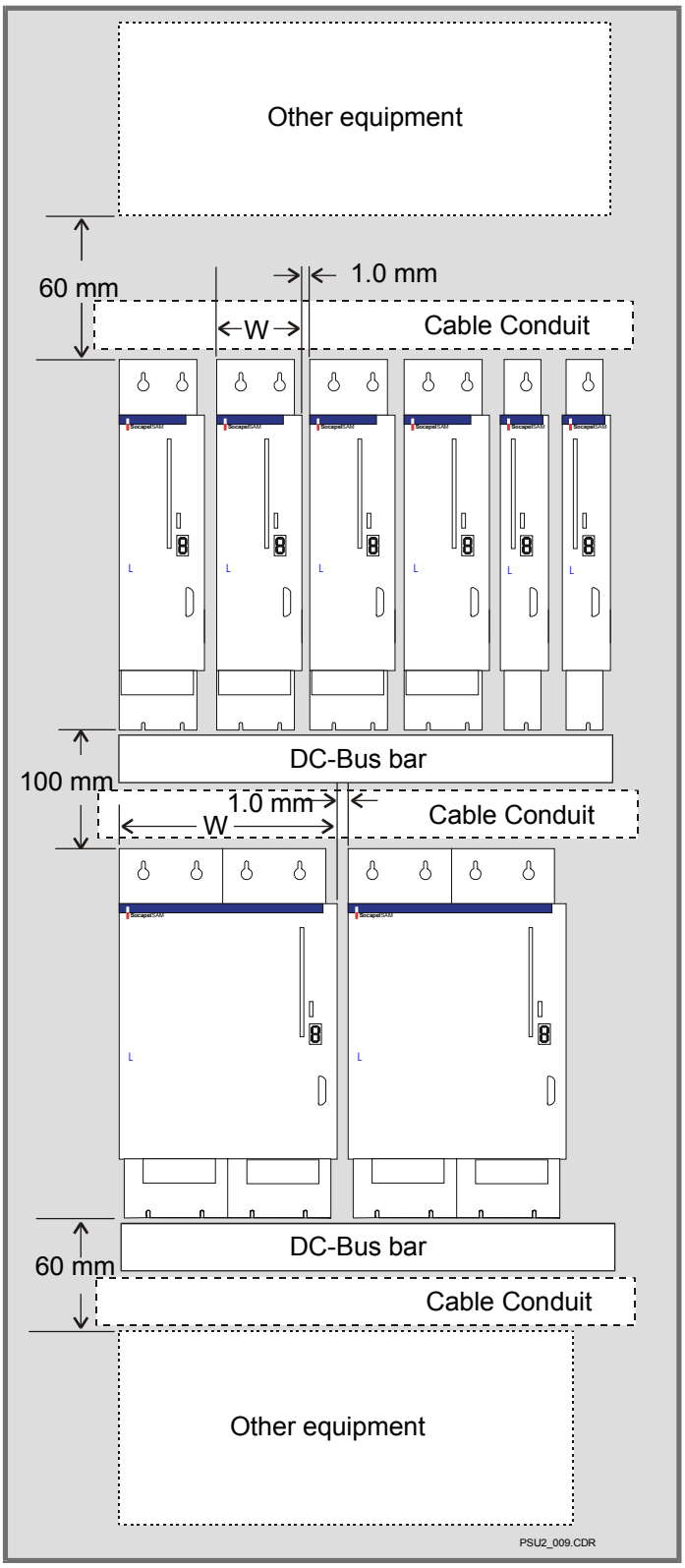


Figure 9 Recommended Spacing and Clearances for SAM Drives and Supplies

PAM

PAM Full System

General

The PAM Full System (See Figure 10) is housed in a panel-mountable chassis which requires a single 24 VDC power source. An integral DC/DC converter provides all other voltages required internally. If the PAM Full Systems includes a fieldbus interface, the system is supplied with the interface hardware and software pre-installed in the chassis.

Normally, the 24 VDC power source providing power for the remainder of the PAM with SAM system is used. For PAM Full System input voltage and current requirements refer to Part 1 - “Selecting System Components”.

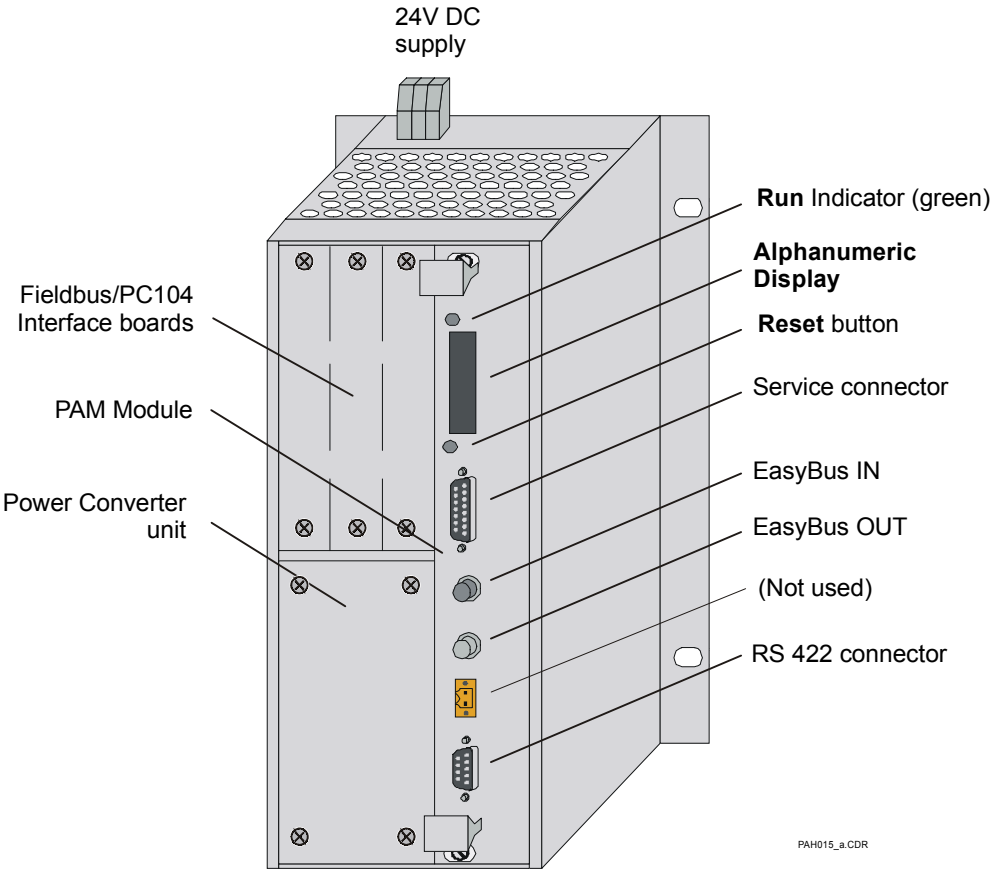


Figure 10 PAM Full System

Fieldbus Interface

Details on interfacing the PAM to a fieldbus are beyond the scope of this manual. Refer to the technical manual for the selected fieldbus interface, which provides hardware and software interfacing information.

Chassis Installation in System Cabinet

The PAM chassis is designed to be panel mounted. Figure 11 shows the chassis mounting dimensions and recommended clearances. The back panel in the area beneath the chassis must paint free as illustrated in Figure 12 to provide intimate contact between the chassis and back panel for EMI/RFI mitigation.

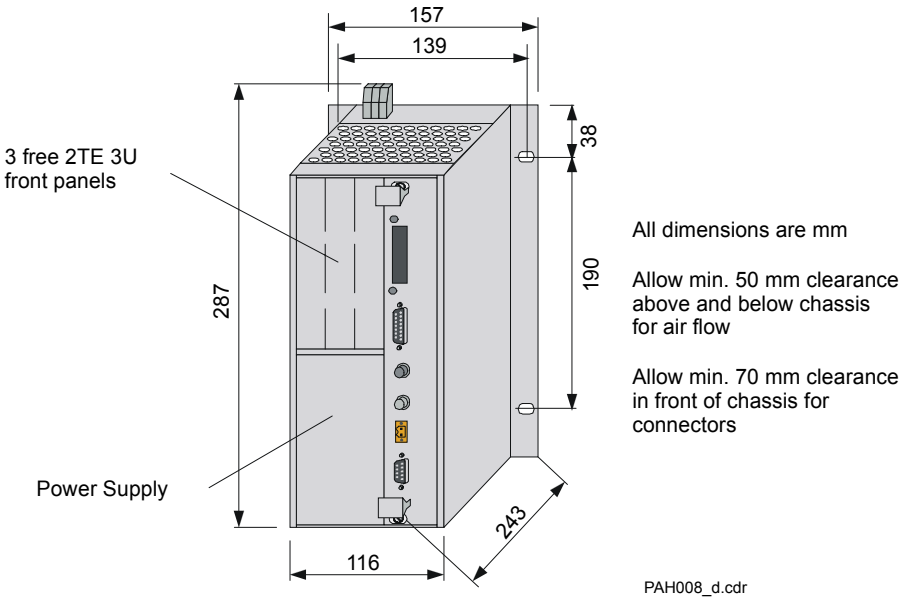


Figure 11 PAM Chassis Mounting Dimensions and Clearances

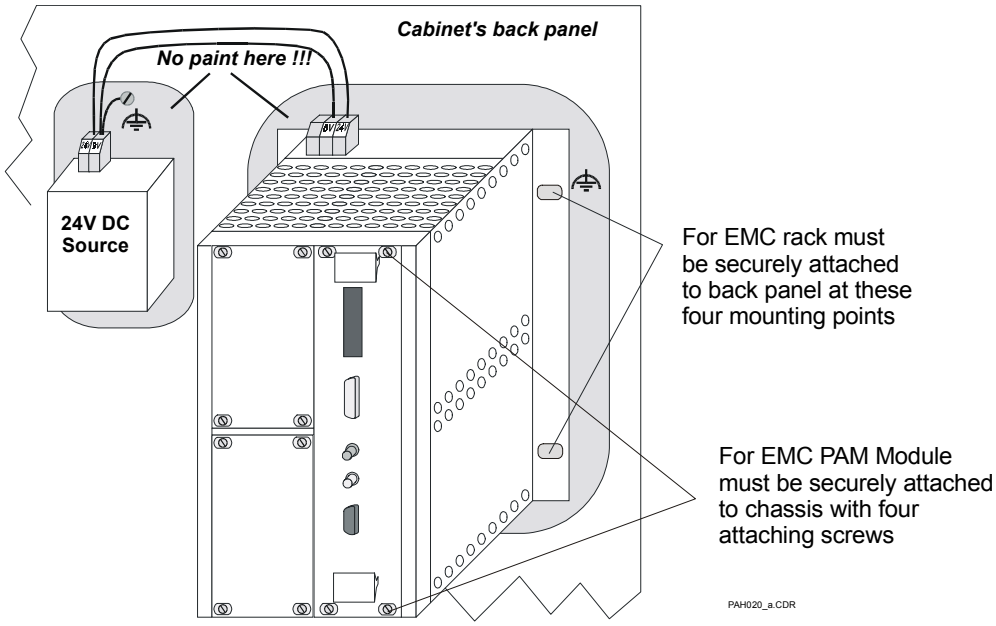


Figure 12 EMI/RFI Requirements when Installing PAM Chassis

PAM-ISA

General

The PAM-ISA (see Figure 13) is intended for direct installation in an ISA Bus slot of a PC. For installation and interfacing information, refer to Part 4 - “PAM Technical Information”.

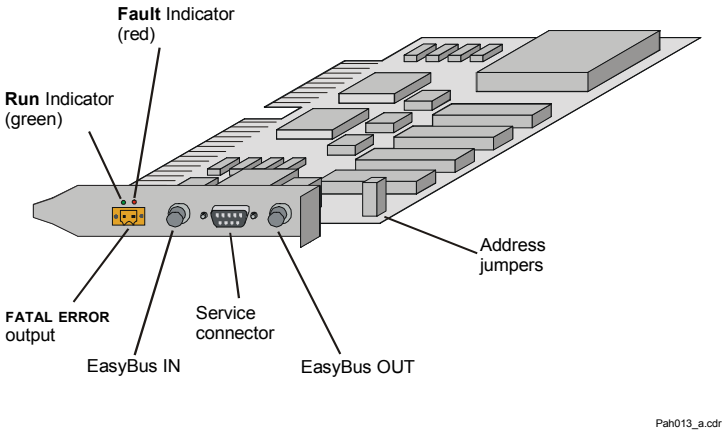


Figure 13 The PAM-ISA

PAM for Simatic Module

General

The PAM for Simatic module (see Figure 14) is intended for direct installation into Siemens’ Simatic S5 PLC chassis. Two configurations of PAM module are available. The PAM module integrated into a plastic housing is for use in the Simatic S5-115. The PAM module with no plastic housing is for use with Simatic S5-135 and S5-155 models.

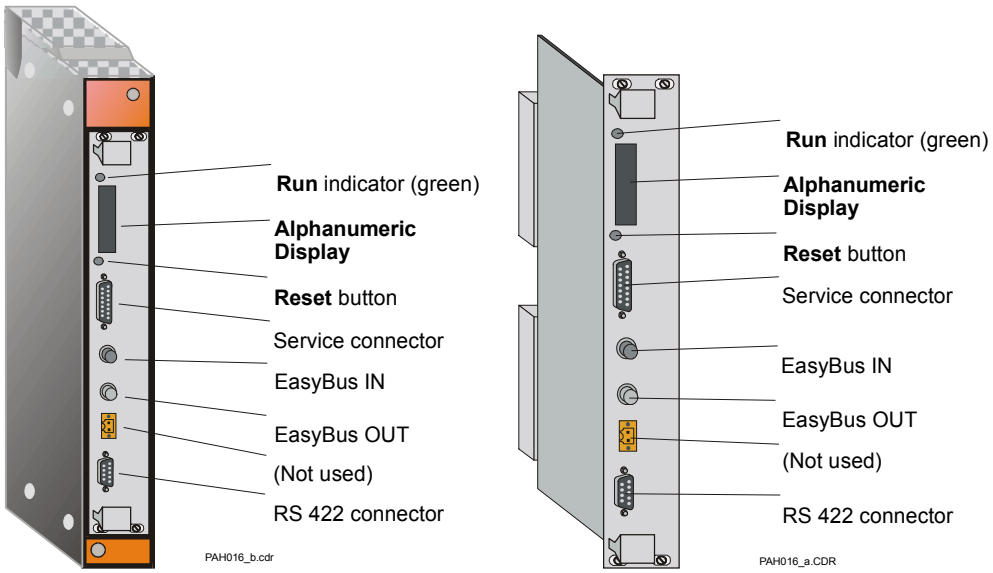


Figure 14 PAM Modules for Simatic S5-115 (left), S5-135 and S5-155 (right)

EasyBus

General

The EasyBus is constructed of fiber optic cable assemblies that link a PAM and all SAM Drives in a PAM with SAM system. Three types of EasyBus cable assemblies are used including:

- Standard duty plastic fiber cables
- Long distance fiber cables
- Kevlar reinforced plastic fiber cables

Refer to Part 1 - “Selecting System Components” for more information

Installation

The following guidelines should be observed when handling and installing EasyBus Cables:

1. Handle the cables carefully. Kinks and bends below the minimum bend radius can destroy the cable.
2. When making EasyBus connections, finger-tighten the connectors only. Never use a wrench as the tightening torque would be too great.

SAM Drive

Mounting a SAM Drive

General

SAM Drives are designed for panel mounting. Mounting tabs above and beneath the unit are provided for securing the unit to the back panel. The mounting tabs are pre-punched with slots for M4 screws.

Setting the EasyBus Node Address

Each SAM Drive must have a unique node address, which assigns a physical drive to logical axis references in the application program. Two sixteen position rotary switches "Node Address (LSB)" and "Node Address (MSB)" (See Figure 32 on page 40) set the Node Address. It is generally easier to set the Node Address switches prior to mounting the SAM Drive.

Chassis Installation in System Cabinet

See “Back Panel Layout” (page 14) for details on laying out the mounting panel for a PAM with SAM system.
For effective EMI-RFI shielding, the SAM Drive must make metal to metal contact with the back panel over the largest possible area. Therefore, the back panel must be unpainted beneath the area where the SAM Drive contacts the back panel.

SAM Drive dimensions are illustrated in Figure 15, Figure 16, and Figure 17. The mounting tabs for all model SAM Drives and Supplies are slotted for M4 screws.

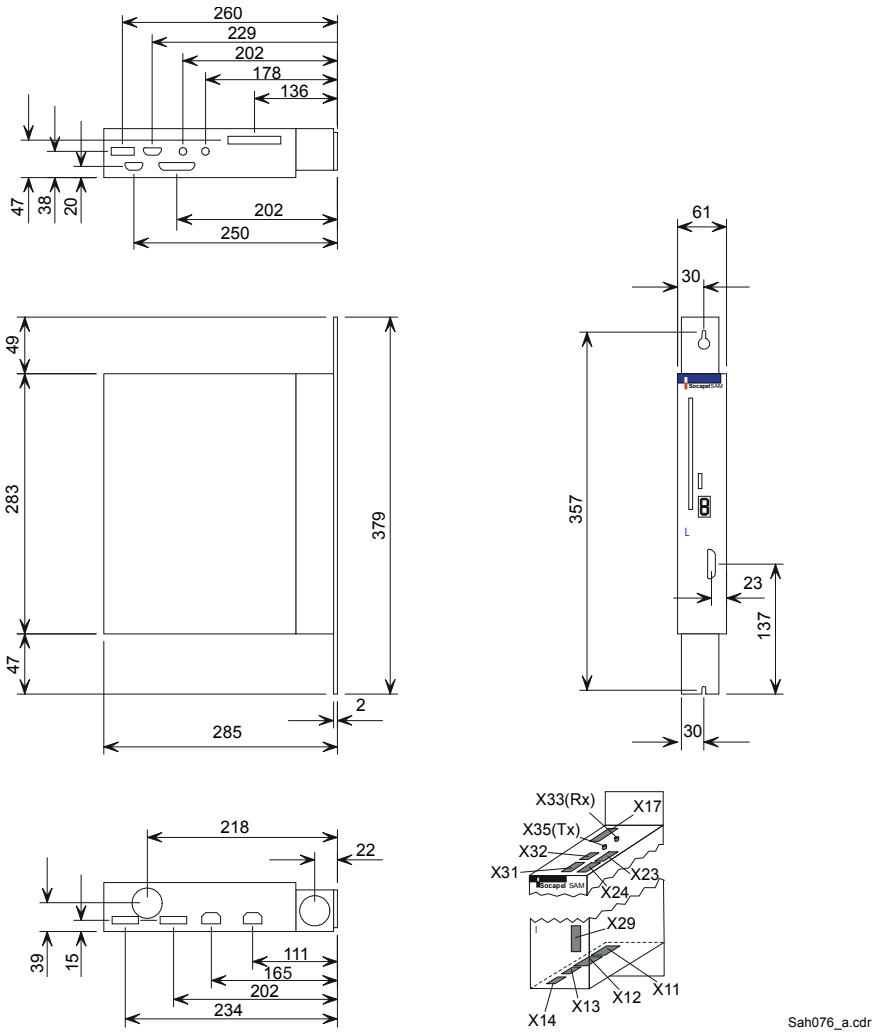


Figure 15 Dimensions for SAM Drive 7 amp Models

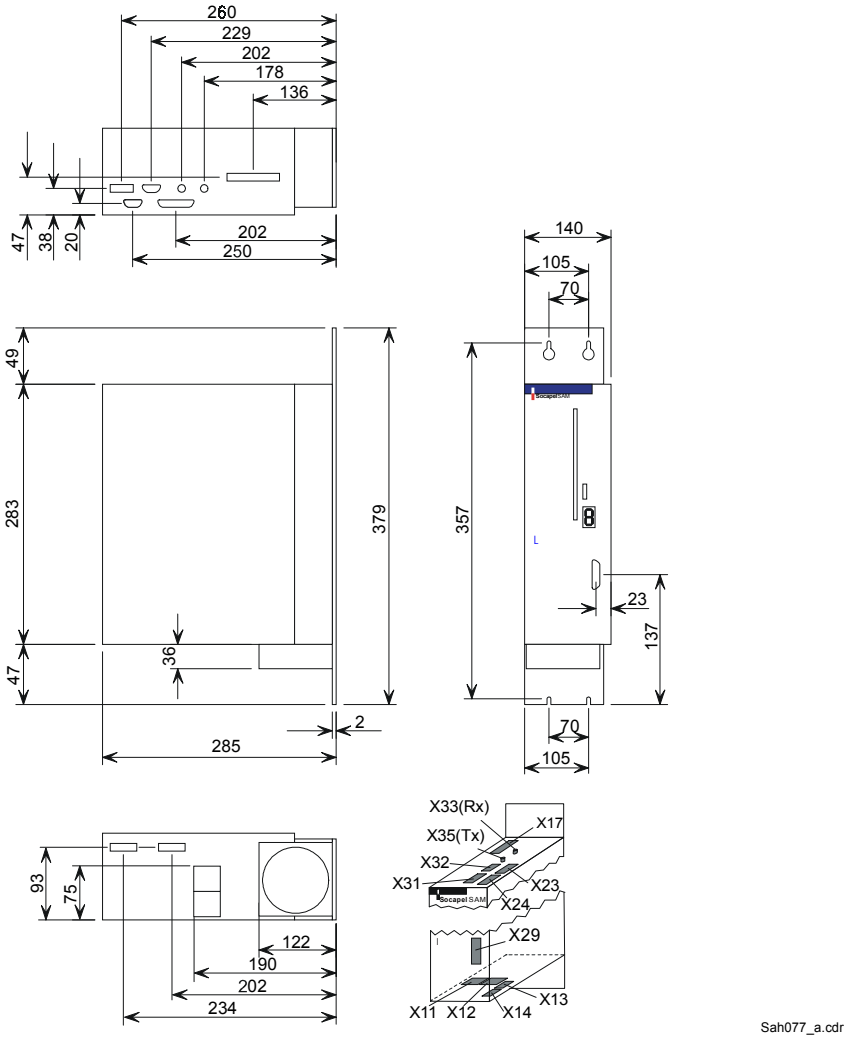


Figure 16 Dimensions for SAM Drive 14 & 28 amp Models

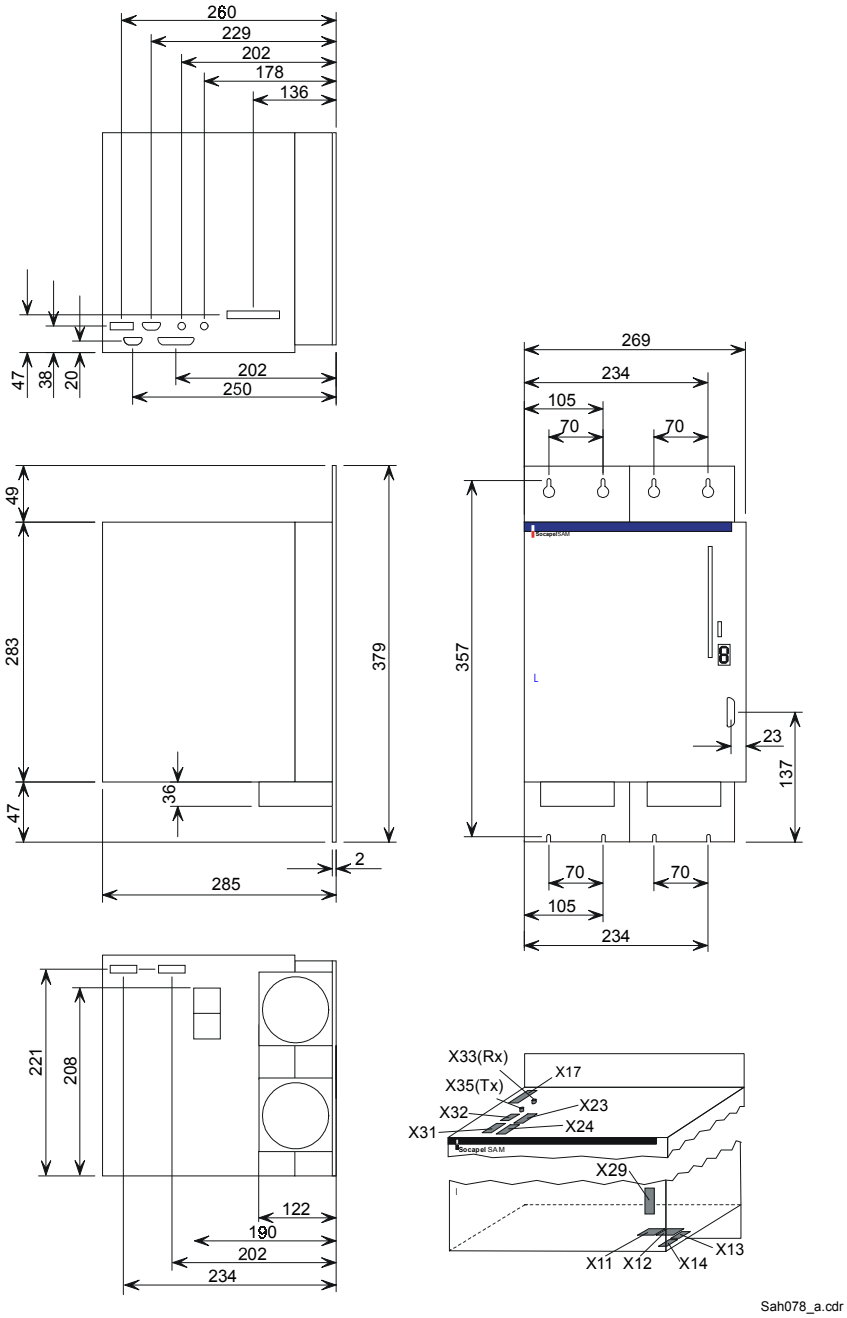


Figure 17 Dimensions for SAM Drive 50 amp Models

Interfacing AC Servomotors

General

This section includes instructions and wiring diagrams specific to servomotor families that were offered together with the PAM and SAM System in the beginning of 1999, namely the “AC Servomotors” and the “Bautz” motors.

For interfacing other motors, the information in this section may be useful but not completely applicable.

Motor-mounted Thermal Protector

The thermal protector is optional and not provided in all motors. When the thermal protector is either not present or not used other steps must be taken to prevent the SAM Drive operating software from interpreting no thermal protector as a motor over-temperature error. The following solutions are available:

- Simulate the thermal protector closed (motor temperature in range) by inserting a wire jumper from X13-2 to X13-3
- In software, modify the SAM Drive Action Masks to prevent the motor thermal protection input (Status B7) from initiating a Stop action

i

Thermal modeling of the axis motor by the SAM Drive operating software is the primary motor overload protection mechanism. The thermal protector mounted in the motor provides secondary protection in the event that the thermal model is incorrect due to environmental factors such as heavy accumulation of dust on the motor, high ambient temperature, poor air circulation, etc.

Brake Control

An external 24 VDC source is required for powering a motor-mounted brake. In some applications, additional user interlocks are inserted in the brake control circuit. The brake control (connector X14) and associated wiring are options that are not present in every configuration.

Interfacing Servomotor types with “C33”-type Terminal Boxes

Figure 19 is applicable for interfacing to all “AC Servomotors” that use a terminal box for motor winding connections (“C33” option). This includes motor types AHD92, AHD115, AHD142, AHD190, AHR92, AHR115, AHR142 and AHR190. Two motor windings cable configurations (see Figure 20) are used depending on the SAM Drive model. The wire colors shown in Figure 19 are for motor windings cables that are supplied together with the PAM and SAM System. The cable gland on the motor end is easily removable when necessary to pull cables through conduit or bulkheads.

For safety, compliance with EMC regulations and satisfactory performance, it is imperative that SAM Drive to motor wiring be exactly as illustrated in Figure 19.

Please note and observe the following instructions and precautions when performing SAM Drive to motor wiring.

1. On the motor flange end, there should be a large area of metallic contact (bare metal) where the motor's mounting face contacts the machine.
2. The motor end of the motor windings cable shields must be properly terminated in a cable gland and the cable gland must make good metallic contact with the terminal box. Figure 18 shows correct preparation of the cable shields for termination in a cable gland.
3. On the SAM Drive end, the screws that secure the cable bracket (and in some cases connector X12) to the SAM Drive must be threaded into the captive nuts on the SAM Drive and tightened because they serve to ground the shield at the SAM Drive end.

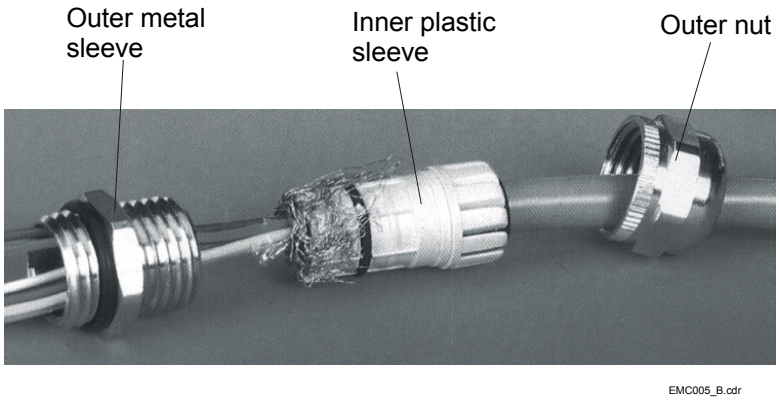


Figure 18 Shields Termination in Cable Gland

There must be metallic contact between the cable shield and cable gland around the whole circumference of the shield. Pigtails degrade the high frequency noise suppression considerably and are not permitted.

The shield must be earthed (grounded) at both ends. High voltage may be present on the shield if either end is left ungrounded.

Machine builders who prefer to fabricate their own motor winding cables should refer to Part 1 - Selecting System Components, which provides some recommendations regarding cable and mating plug selection.

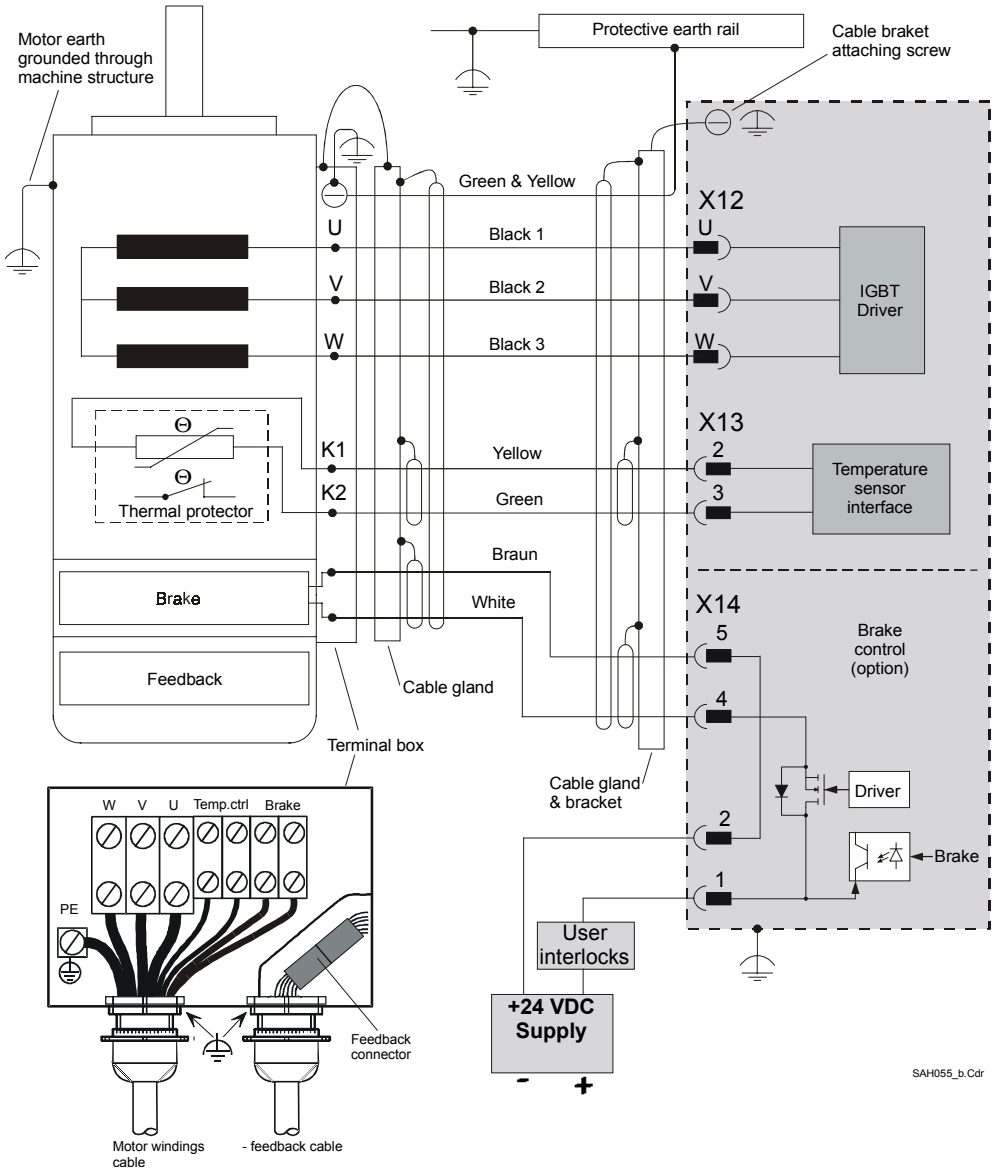


Figure 19 Wiring Diagram for "AC Servomotors" with Terminal Boxes ("C33" option)

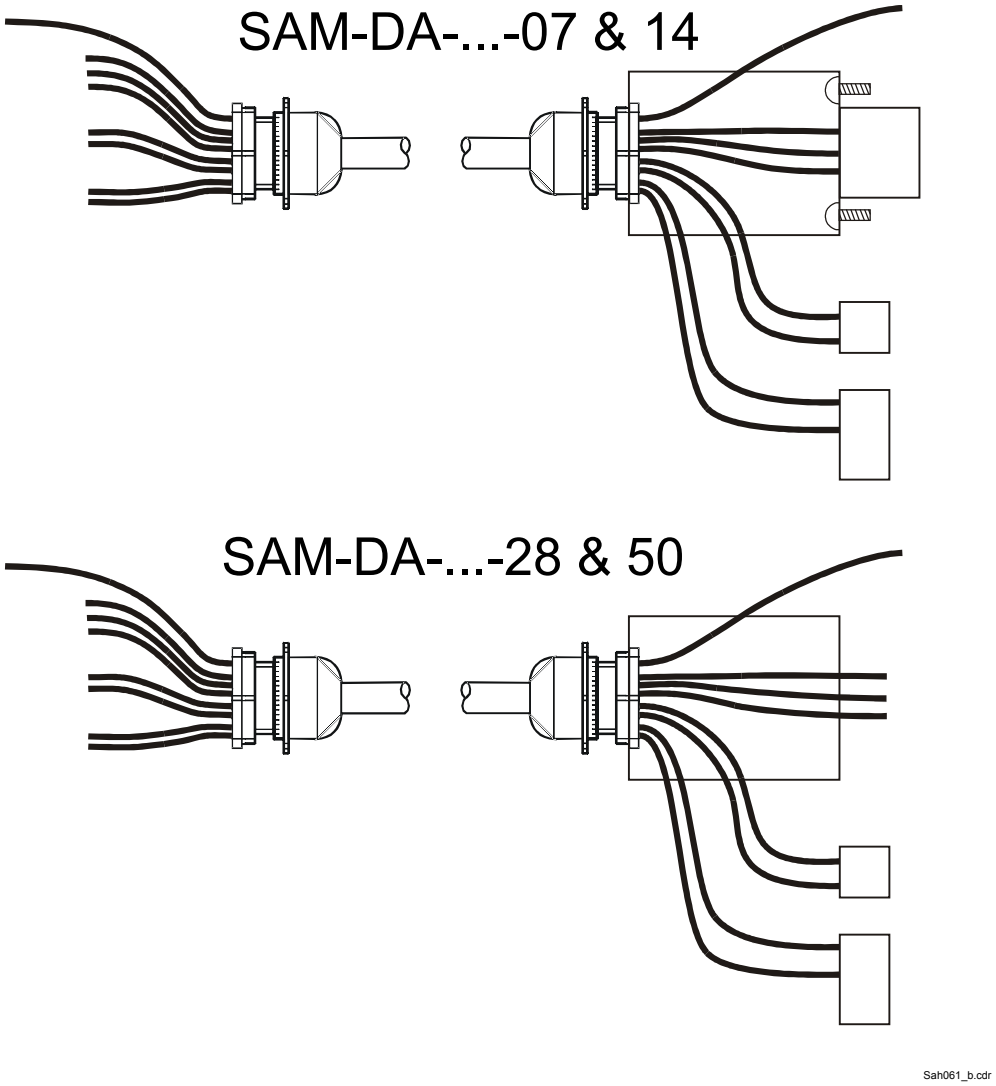


Figure 20 Motor Windings Cable Configurations

Interfacing Servomotor types with Integral Mating Connectors

Figure 21 is applicable for interfacing Servomotor types with integral mating connectors for motor winding connections. This includes motor types AHD55, AHD70, M254 and M506. The wire colors shown in Figure 21 are for motor winding cables that are supplied with the PAM and SAM System.

The plug-fitted motor windings cable configuration (see Figure 22) is used for interfacing to the SAM SA-400-07 & 14 models. The connector assembly on the SAM Drive end is removable when necessary to pull cables through conduit or bulkheads. For safety, compliance with EMC regulations and satisfactory performance, it is imperative that SAM Drive to motor wiring is exactly as illustrated in Figure 21.

On the motor end, there should be a large area of metallic contact (bare metal) where the motor's mounting face contacts the machine. On the SAM Drive end, the screws that secure the cable bracket (and in some cases connector X12) to the SAM Drive must be threaded into the captive nuts on the SAM Drive and tightened because they serve to ground the shield at the SAM Drive end.

The shield must be earthed (grounded) at both ends. High voltage may be present on the shield if either end is left ungrounded.

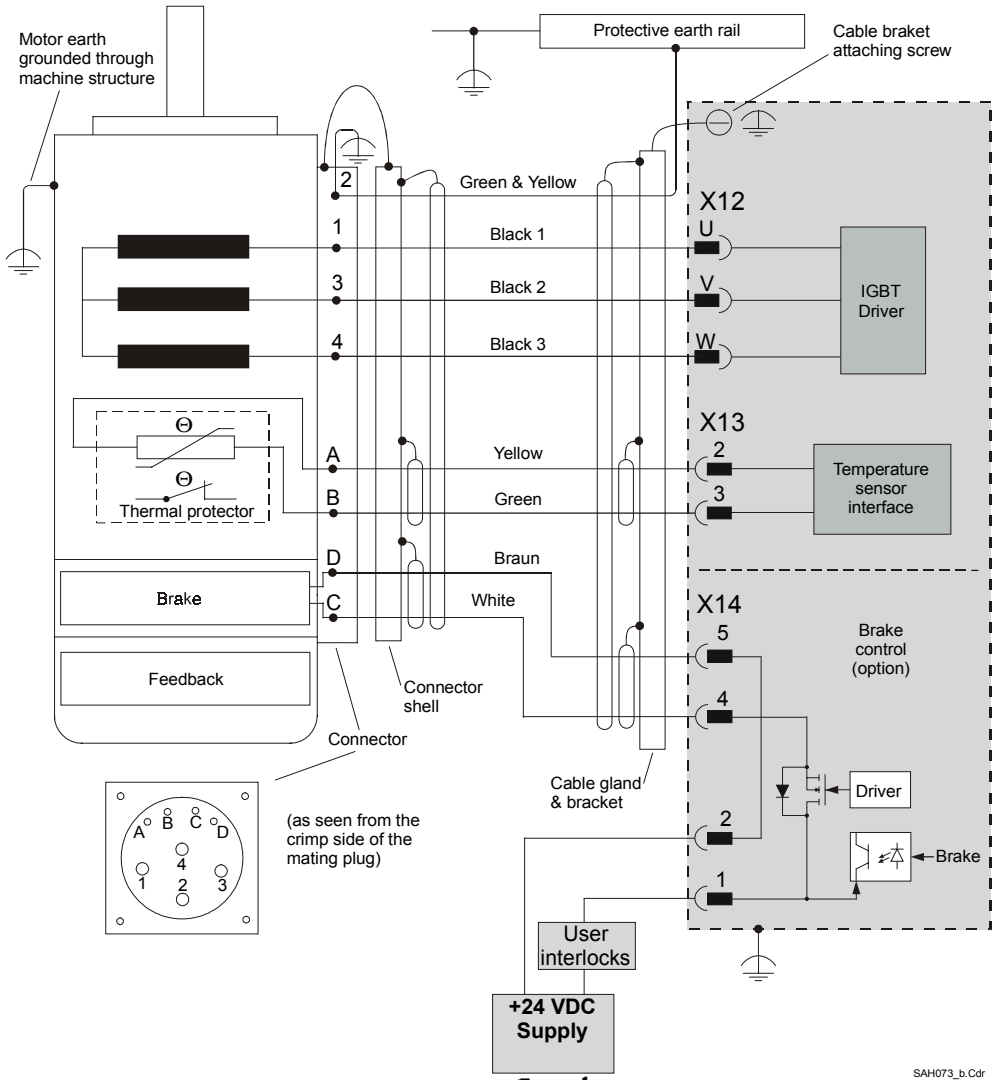


Figure 21 Wiring Diagram for motors with Integral Mating Connectors

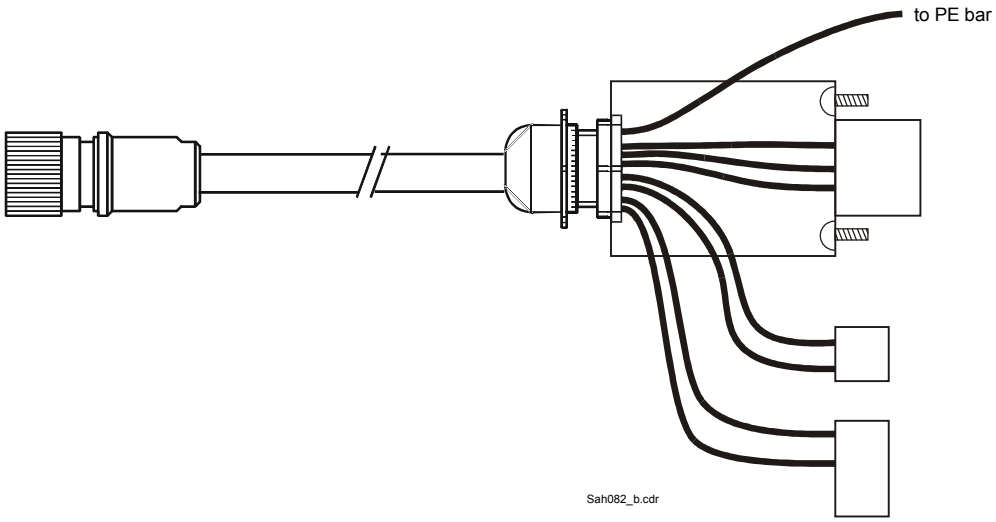


Figure 22 Plug-fitted Motor Winding Cable Assembly

Interfacing Standard Resolvers

General Information

This section includes instructions and wiring diagrams specific to servomotor families that were offered together with the PAM and SAM System in the beginning of 1999, namely the “AC Servomotors” and the “Bautz” motors.

For interfacing other motors, the information in this section may be useful but not completely applicable.

Interfacing Servomotor types with “C33”-type Terminal Boxes

Figure 23 shows the resolver cable configuration for all “AC Servomotors” that use a terminal box for motor winding connections (“C33” option). This includes motor types AHD92, AHD115, AHD142, AHD190, AHR92, AHR115, AHR142 and AHR190. On the motor end, the resolver connections are terminated in an eight (8) pin connector in a separate compartment of the terminal box. To make the resolver connections on the motor end, perform the following steps:

1. Remove the cable gland outer metal sleeve (see Figure 18) from the feedback cable.
2. Insert the cable gland outer metal sleeve into the mating hole in the terminal box and secure it to the terminal box with the locking nut.
3. Insert the rectangular connector of the feedback cable through the cable gland outer metal sleeve and mate it with the resolver feedback connector.
4. Insert the cable gland inner plastic sleeve into the cable gland outer sleeve. For satisfactory performance and compliance with EMC regulations, it is imperative that the feedback cable shield is terminated as illustrated in Figure 18.

There must be metallic contact between the cable shield and cable gland around the whole circumference of the shield. Pigtails degrade the high frequency noise suppression considerably and are not permitted.

5. Tighten cable gland outer nut.
6. On the SAM Drive end, plug the mating connector into X24.

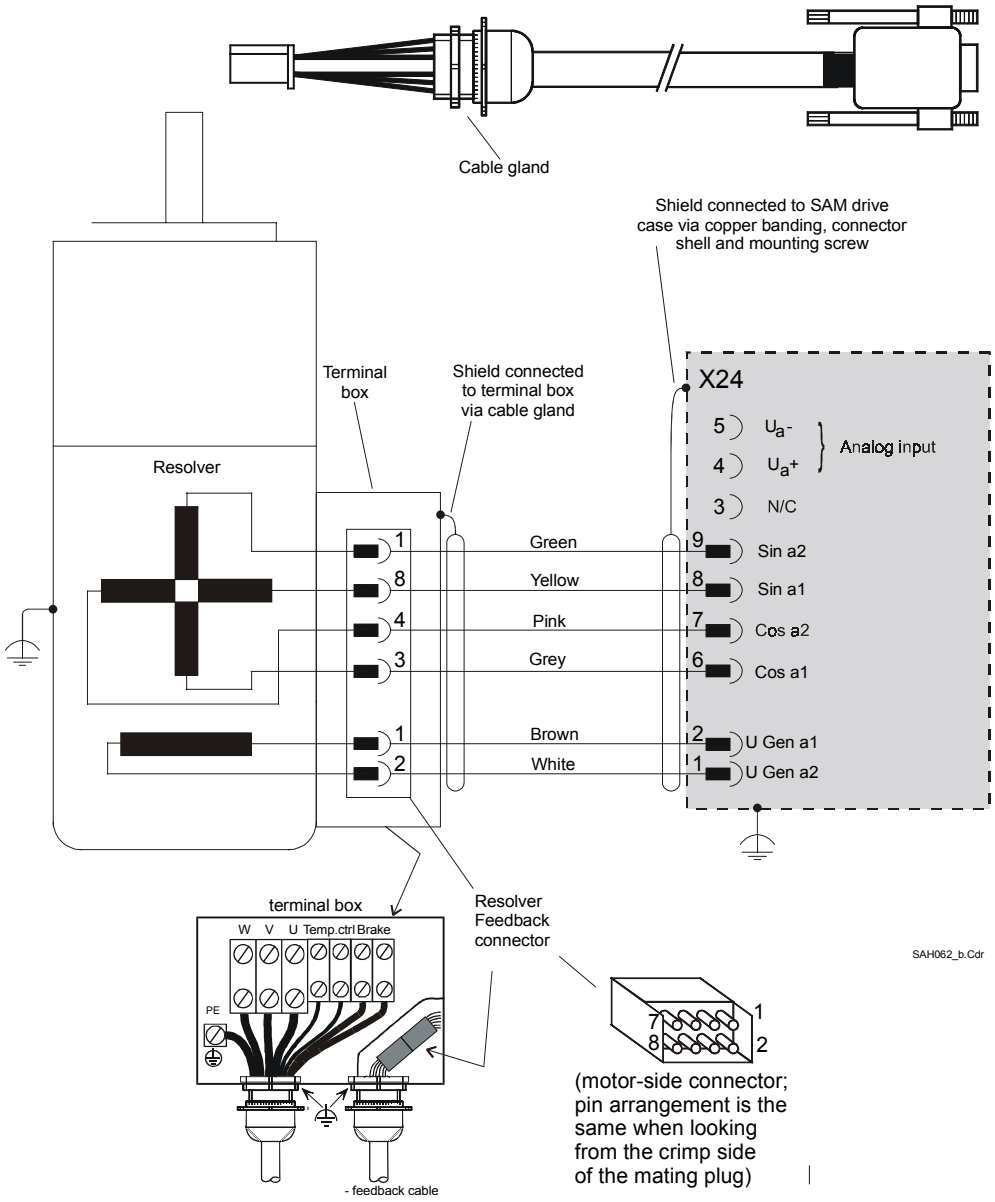


Figure 23 Resolver Feedback Interface for AC Servomotors with Terminal Boxes

Interfacing Servomotor types with Integral Mating Connectors

For interfacing Servomotor types with integral mating connectors (motor types AHD55 & AHD70 and M254 & M506), simply connect the resolver feedback cable to its mating connectors on the motor and SAM Drive as illustrated in Figure 24.

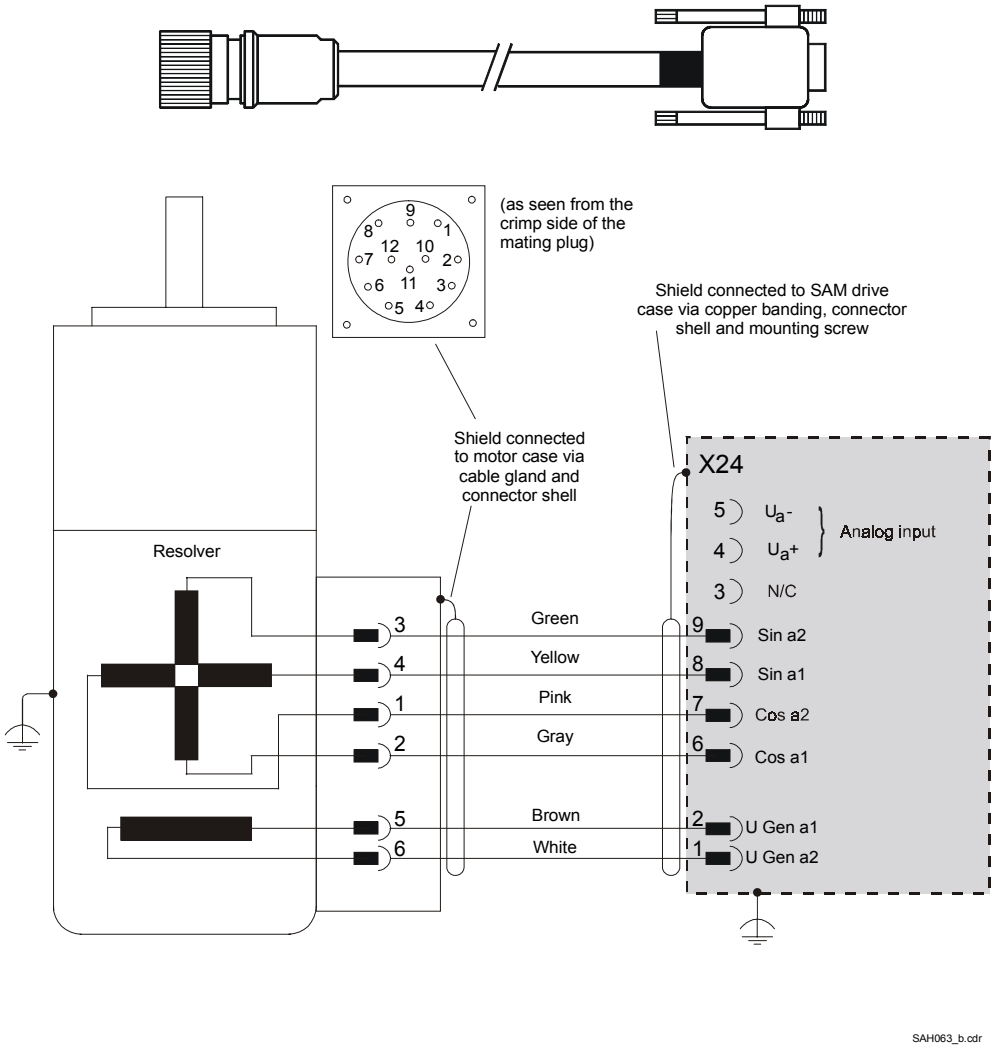


Figure 24 Resolver Feedback Interface for ACC & Bautz Motors with Integral Connectors

Interfacing Sine-Cosine Encoders and Rulers

Guidelines for Mechanical Integration

Several motors with Sine-Cosine Encoders are available together with the PAM and SAM System. When using a linear motor, or a direct-drive, “torque” motor, the user has to assemble the encoder by himself. These recommendations cover this kind of applications, and are valid for Rulers as well as for Encoders.

Users performing their own integration of a feedback device with a motor must pay close attention to the mechanical interface. Misalignment, backlash and other interfacing errors translate to position error at the motor shaft. Any resonance should be carefully damped.

In order to realize the high precision and high servo stiffness possible with high resolution sine-cosine encoders, particular care and attention must be paid to the mechanical interface with the motor. ACC offers the following recommendations:

- Often, the best solution is to install the encoder rotating and stationary parts directly onto the motor shaft and into the motor housing respectively.
- When using a coupling between motor end encoder, select a very stiff, zero backlash coupling. Belt coupling is to be avoided.
- A statoric coupling is preferred over a rotoric type coupling such as a bellows.
- Mechanical misalignment between motor shaft end encoder induces a periodic positioning error proportional to the severity of misalignment. Design the mechanical interface to minimize misalignment and maintain the encoder securely in alignment with the motor shaft.
- For applications requiring very high servo stiffness, please contact ACC for application assistance.

Electrical Interface

Figure 25 shows the wiring diagram for interfacing sine-cosine encoders that are supplied together with the PAM and SAM System.

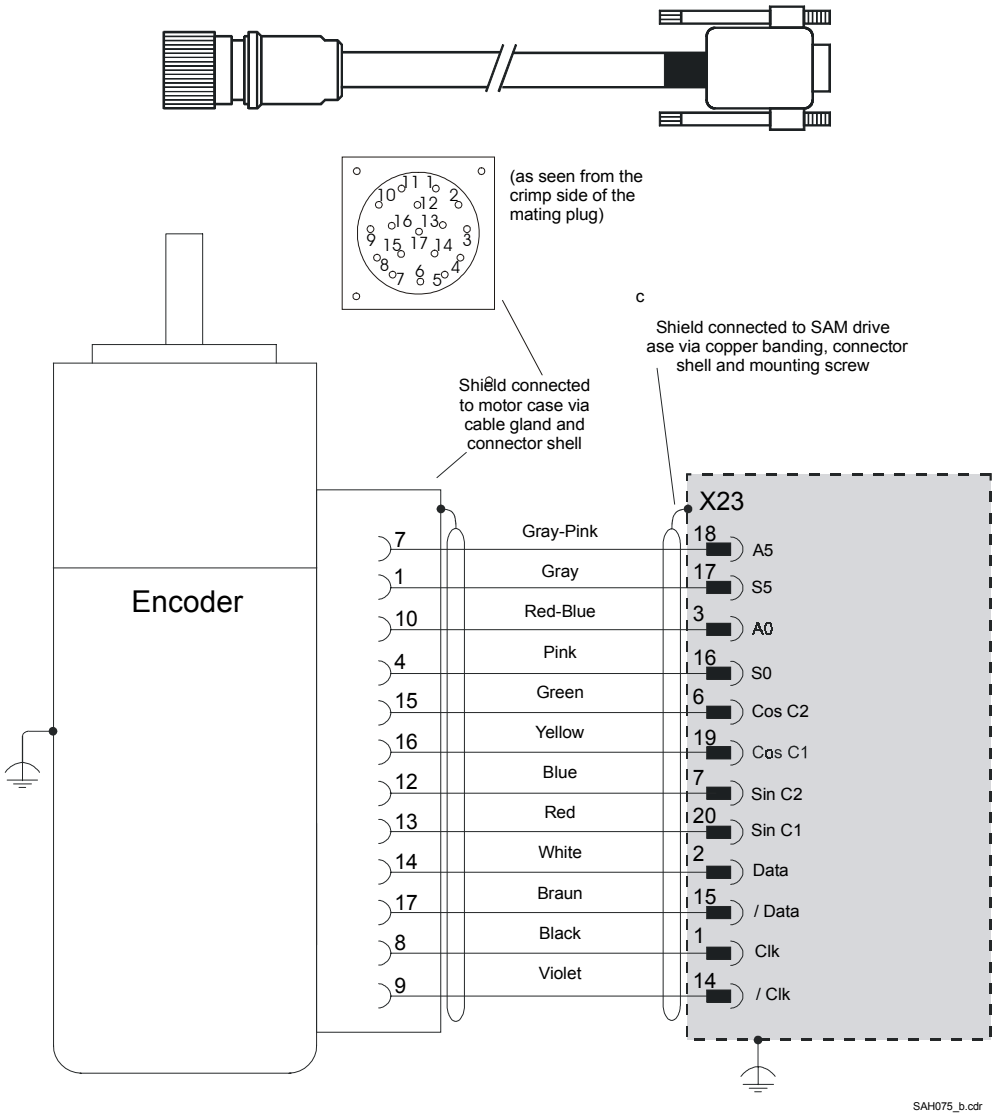


Figure 25 Wiring Diagram for Sine-cosine Encoders

Interfacing Multi-turn Resolvers

Figure 26 shows the wiring diagram for interfacing multiturn resolvers that are supplied together with the PAM and SAM System

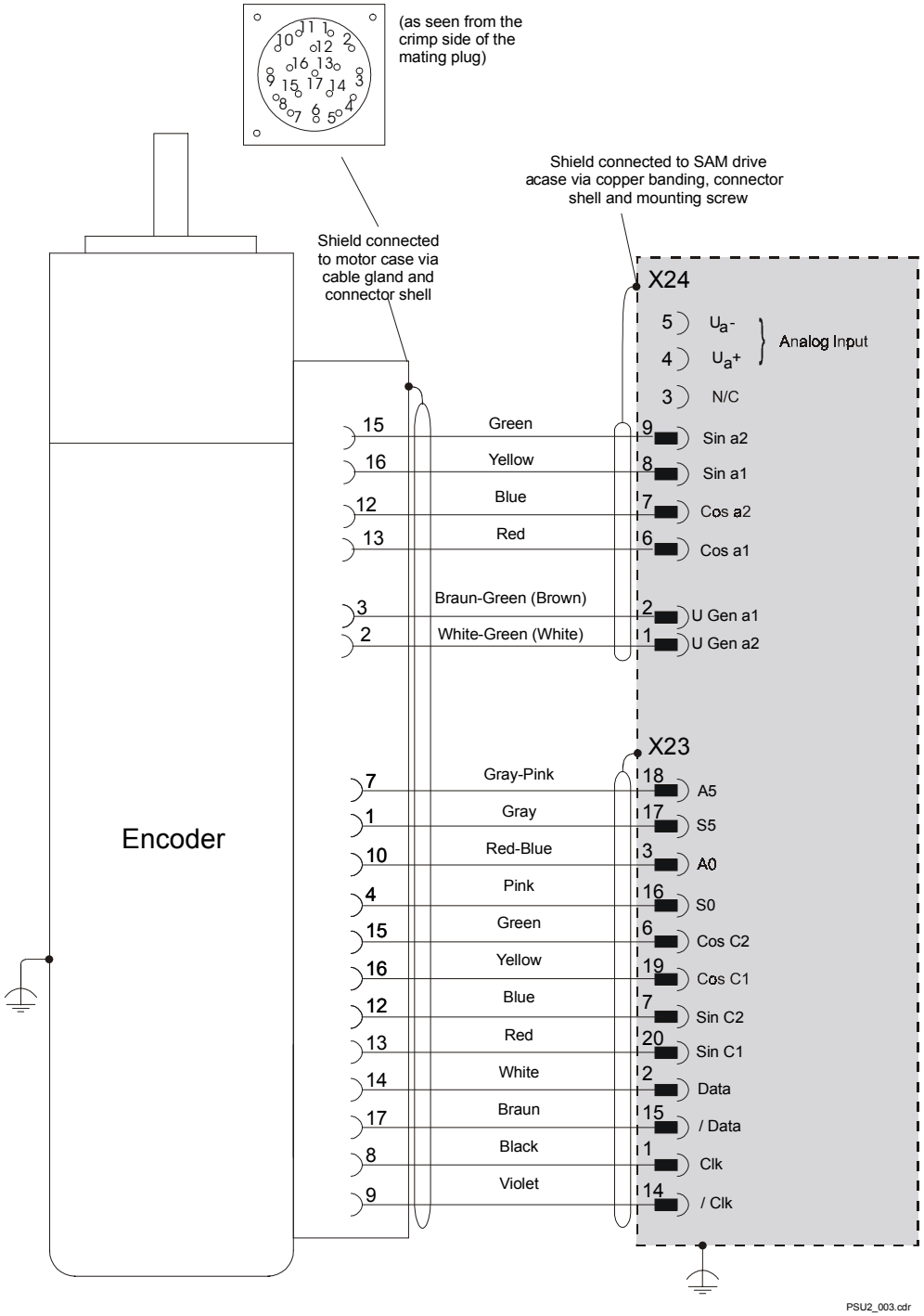


Figure 26 Wiring Diagram for Multi-turn Resolvers

Safety I/O & 24 VDC Supply

24 VDC power for the SAM Drive and user safety functions interface through connector X17. Safety inputs are isolated from internal SAM Drive electronics and share a common return line.

Figure 27 illustrates a typical wiring diagram. Refer to Part 3 - “Safety and Protective Functions” for a functional description of User Stop inputs and the Fatal Error output. Refer to Part 5 - “SAM Drive Technical Information” for safety input/output signal specifications and 24 VDC power requirements.

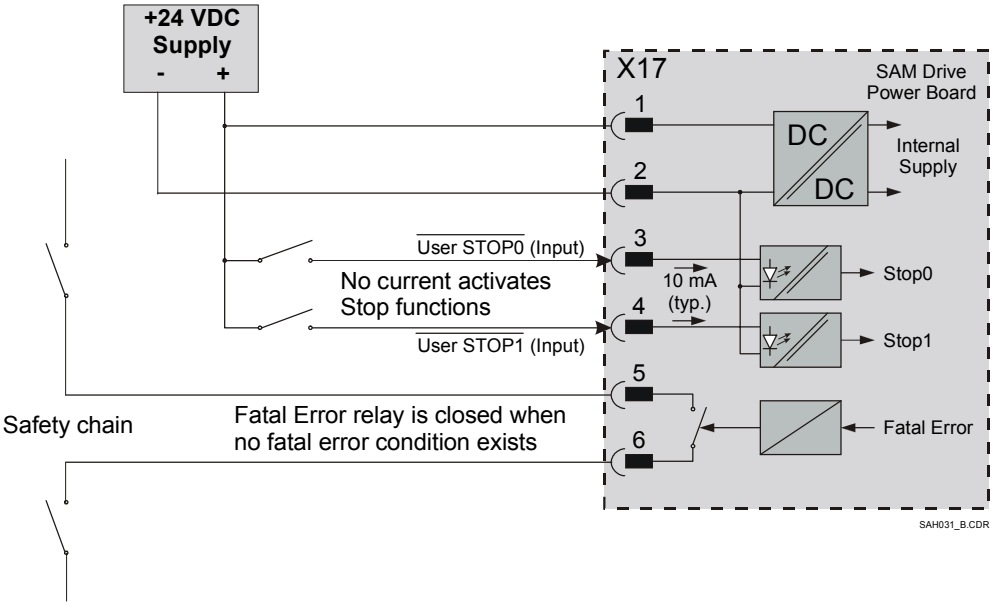


Figure 27 Safety I/O and 24 VDC Power Wiring Diagram

User I/O

General

Two User I/O configurations, standard and expanded I/O, are available depending on the SAM Drive model. SAM Drive models SAM-DA-400-…-…-E incorporate the standard User I/O configuration and SAM-DA-400-…-…-F models have the expanded User I/O configuration.

All user inputs and outputs are isolated from the internal SAM Drive electronics and share common power and ground return lines. LED indicators located on the SAM Drive front panel display the state of each input/output. Refer to Part 5 - “SAM Drive Technical Information” for user input and output signal specifications.

Standard User I/O Configuration ("E" option)

Figure 28 illustrates a typical interface to the standard I/O configuration. For all signals except **USER FAST IN 1**, the user connection may be made to either connector X31 or X32.

Signals applied to **USER FAST IN 1** should be high quality, "clean" signals with sharp rising and falling edges, no bounce and no ringing. They require shielded connections and can be thus connected only to X32 (D-sub type connector).

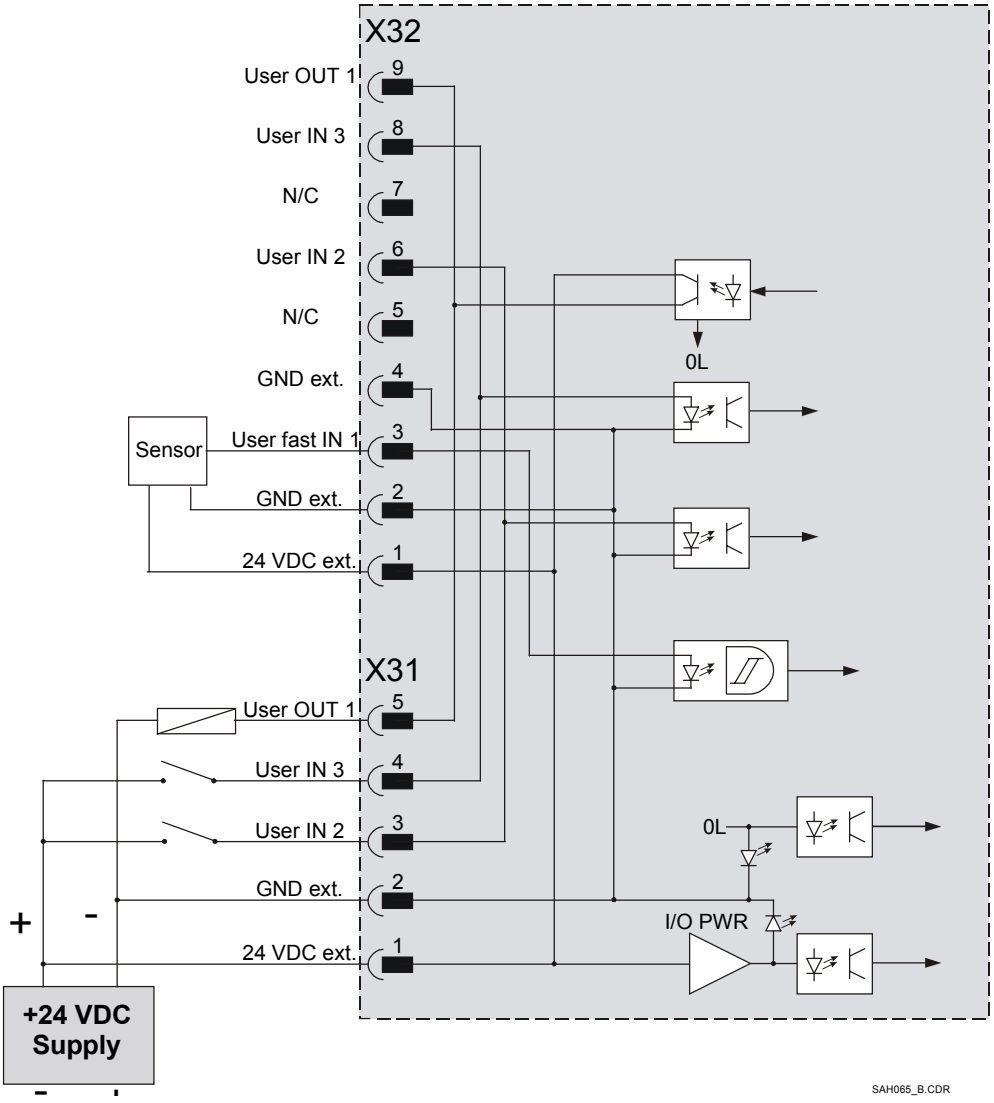


Figure 28 User Interface to Standard I/O Configuration

Expanded User I/O Configuration

Figure 29 shows the functional schematic for the expanded user I/O option. With this configuration, four (4) user I/O (X32-12, 11, 10, and 9) are user-configurable to function as inputs or outputs.

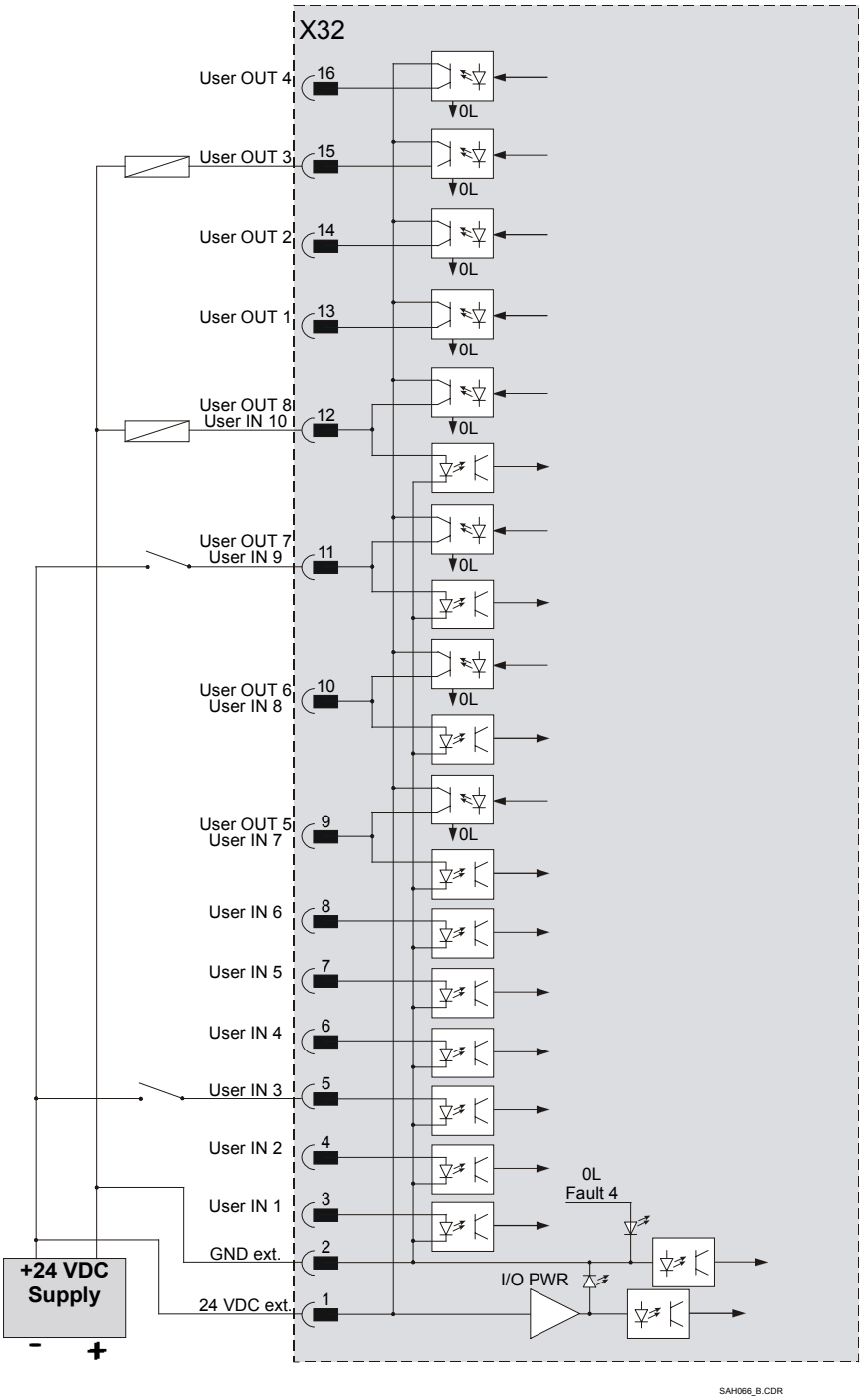


Figure 29 User Interface to Expanded I/O Configuration

Connector Pin Assignment

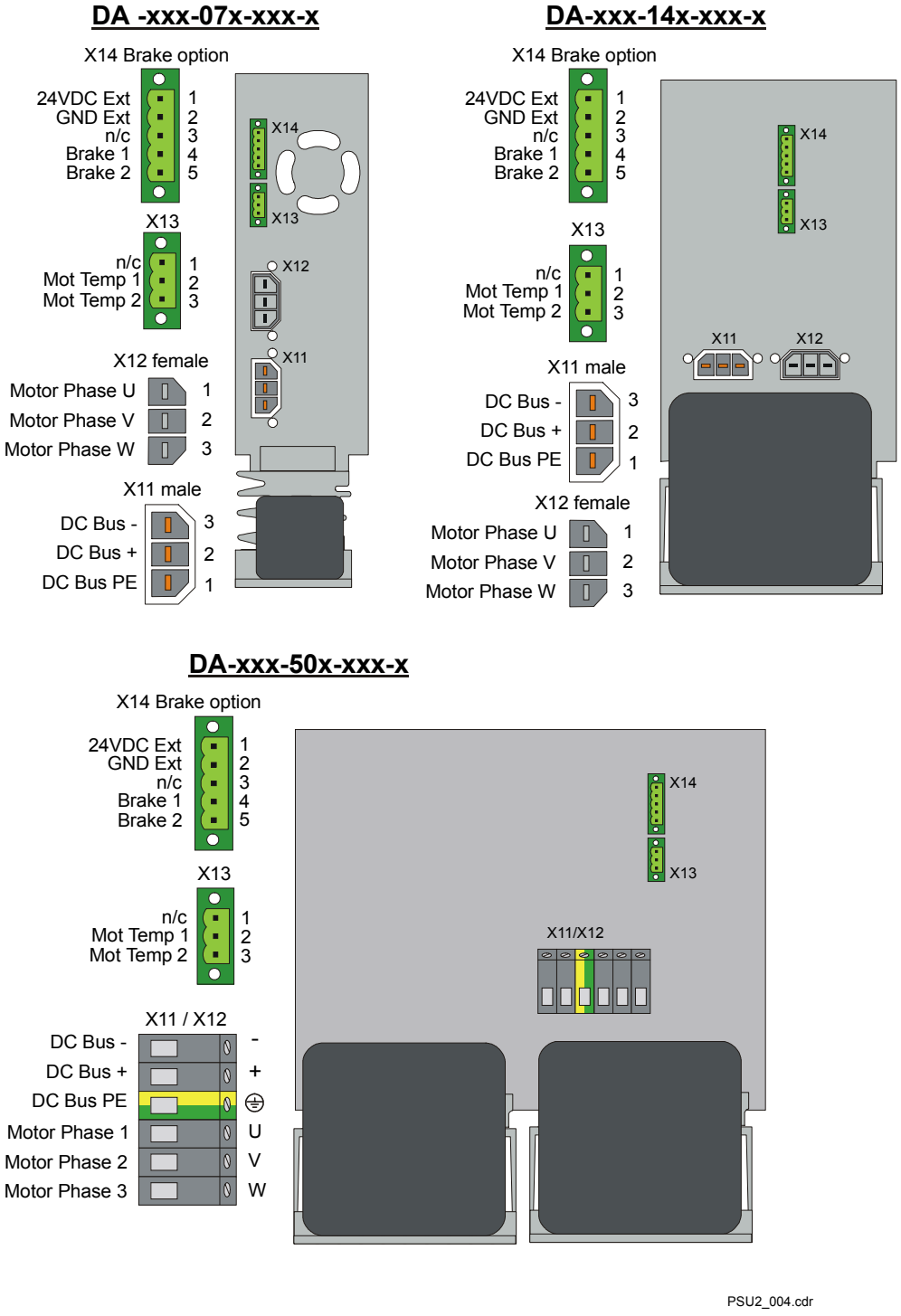


Figure 30 DC Bus, Motor Windings, Thermal Protector and Brake Control Connectors

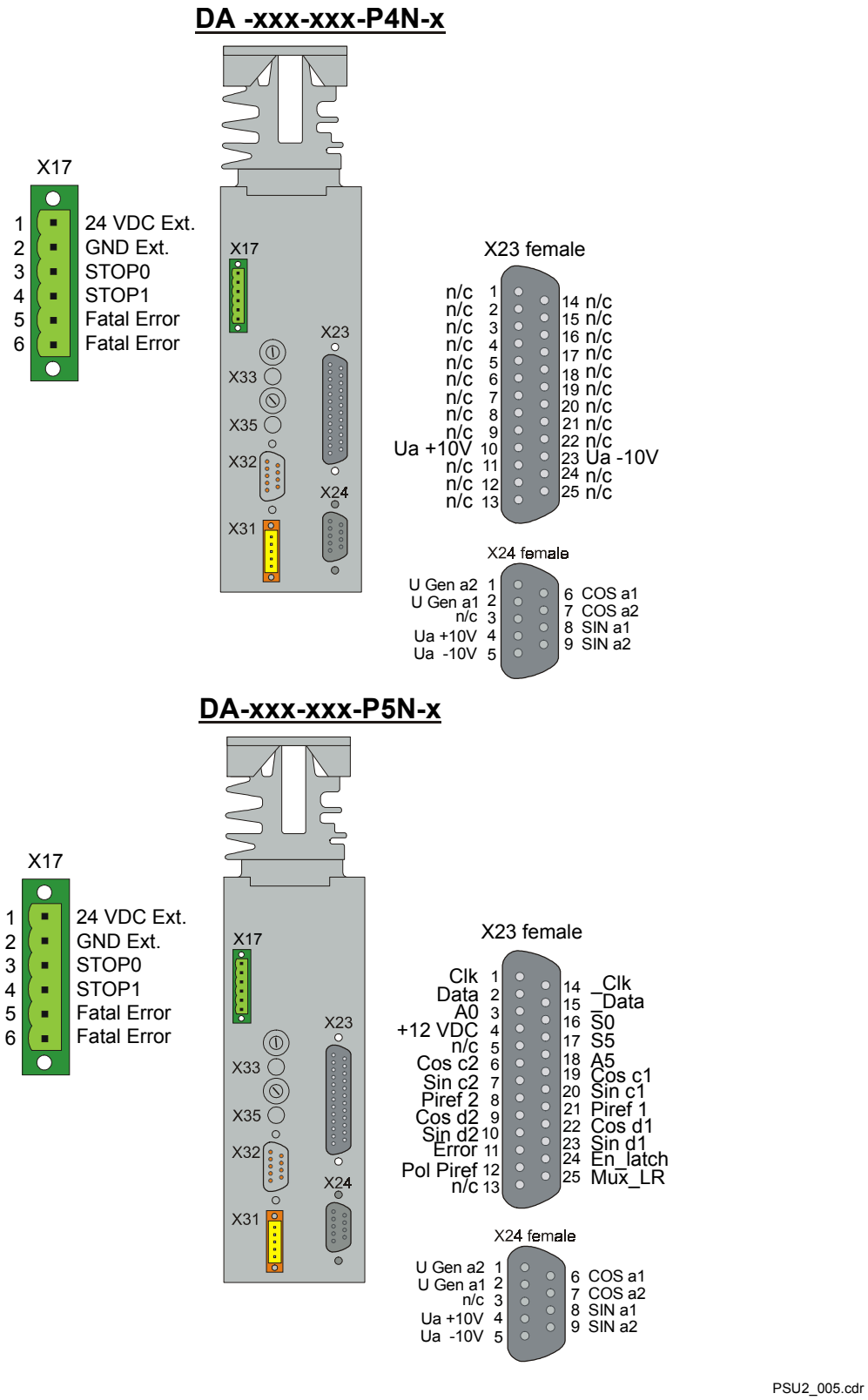


Figure 31 24 VDC Power, Safety and Position Feedback Connectors
(The 14, 28 and 50 amp models are wider than shown in this figure)

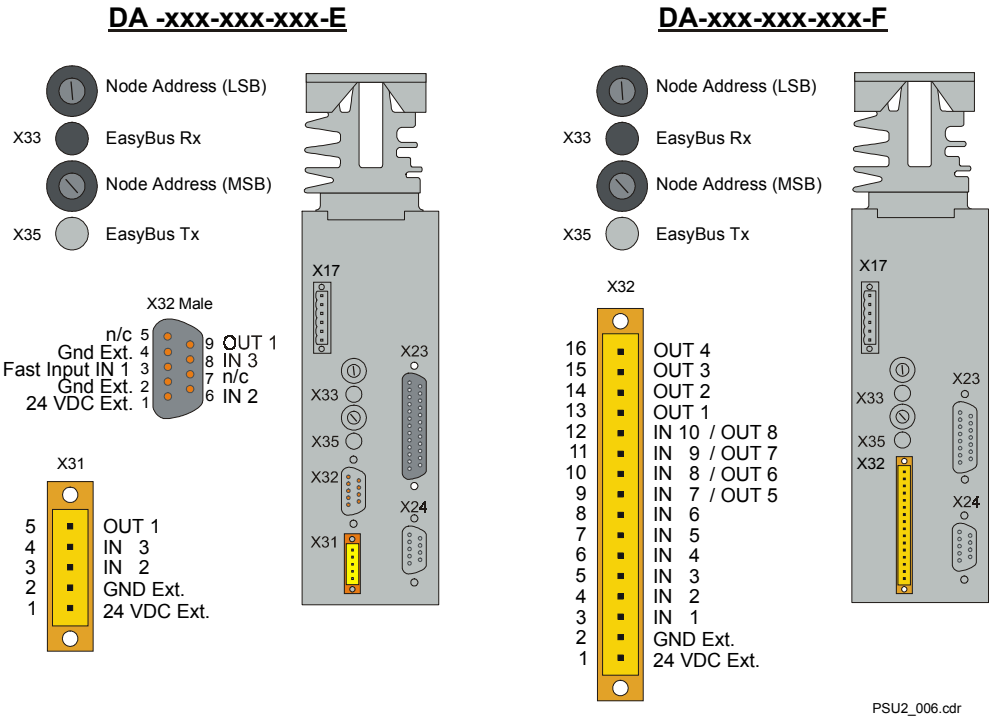


Figure 32 EasyBus and User I/O Connectors
(The 14, 28 and 50 amp models are wider than shown in this figure)

SAM Supply

Chassis Installation in System Cabinet

STOP

See “Back Panel Layout” (page 14) for details on laying out the mounting panel for a PAM with SAM system.

For effective EMI-RFI shielding, the SAM Supply must make metal to metal contact with the back panel over the largest possible area. Therefore, the back panel must be unpainted beneath the area where the SAM Drive contacts the back panel.

Figure 33 and Figure 34 show dimensions for 30 and 80 amp SAM Supply models.

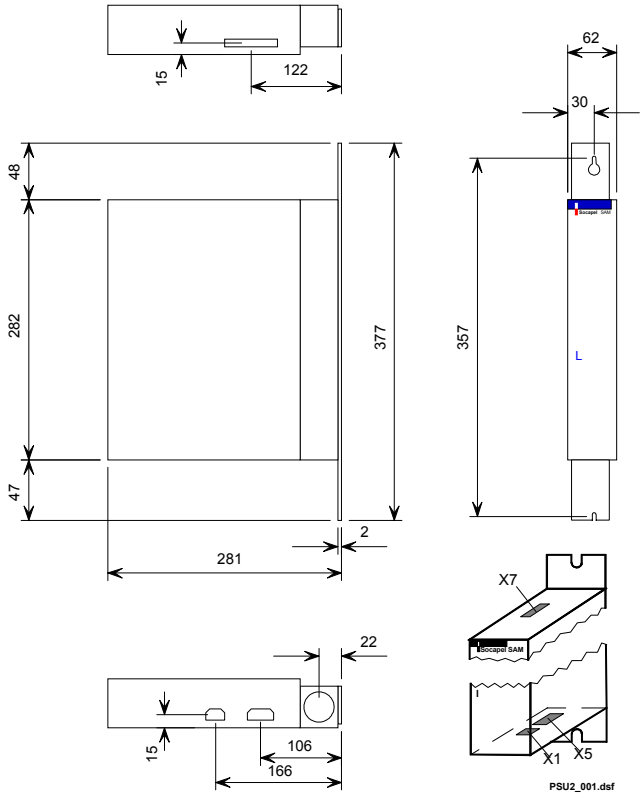


Figure 33 Dimensions for SAM Supply 30 amp Models

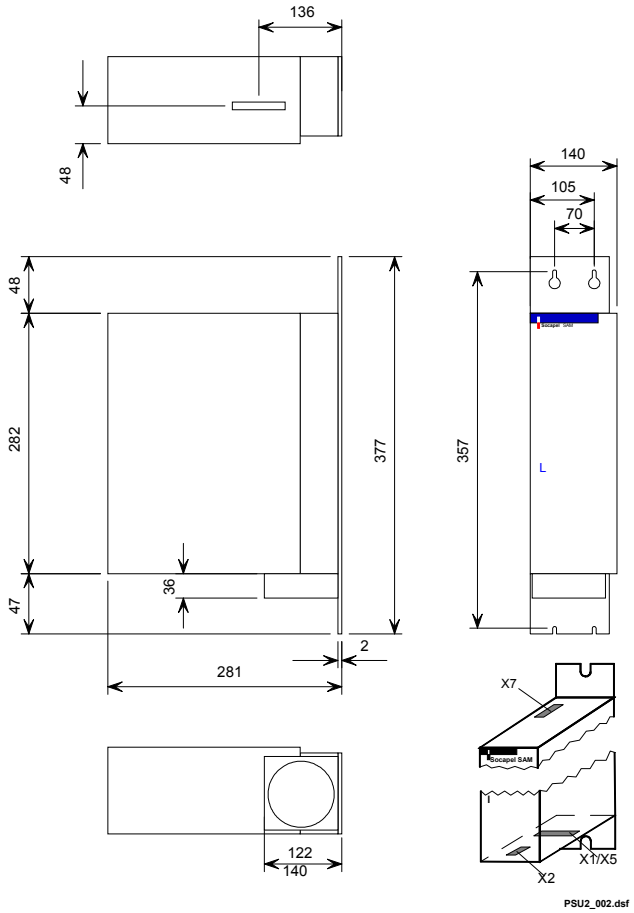


Figure 34 Dimensions for SAM Supply 80 amp Models

AC Supply Input

Figure 35 illustrates three phase AC Supply connections to a SAM Supply. The AC Supply voltage applied to a SAM Supply must meet the following requirements:

1. The voltage must be within the limits specified for the SAM Supply model (see Part 1 - “Selecting System Components”).
2. The AC Supply must have a grounded neutral (see Protective Earth Grounding Requirements on page 8).
3. The Feeding Section must provide the necessary short-circuit and over-current protections (i.e. fuses or circuit breaker).
4. Necessary safety and interlocks must be built into the AC Supply input circuit (see Part 3 - “Safety and Protective Functions”).

Operating a PAM with SAM system from an ungrounded AC Supply is prohibited.

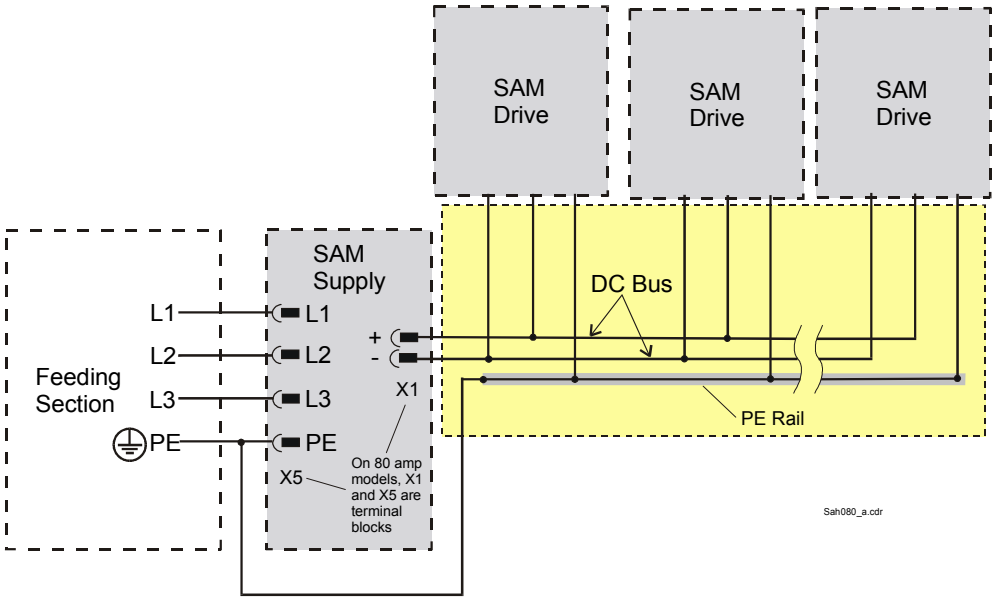


Figure 35 AC Supply and DC Bus Connections to SAM Supply

DC Output

The SAM Supply produces DC power at high voltage (up to 800 VDC) and current levels for use by SAM Drives in powering axis motors. Distribution of this DC power to the SAM Drives is the function of the DC Bus (See DC Bus, page 49).

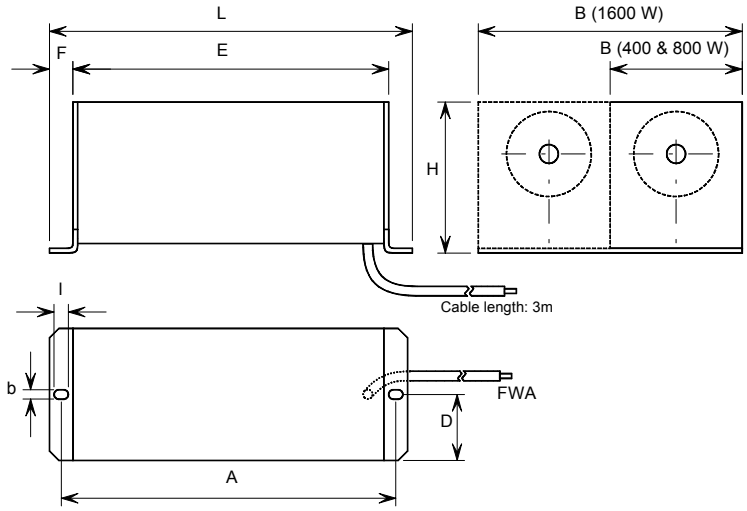
External Dynamic Braking Resistor

General

SAM Supply models SAM-PA-…-…-E require an external DB resistor for dissipating excess regenerated energy from motors when it cannot be immediately reused by other SAM Drives. SAM Supply models SAM-PA…-30-I have an internal DB resistor. For these models, no external DB resistor is used.

DB Resistor Installation and Mounting

If the average braking power "$P_{BRAKE\_AV\_TOTAL}$" (see Part 1 - System Component Selection") is high, the DB resistor should be placed outside of the equipment enclosure in order to reduce the heat load within the enclosure, and thus simplify its cooling. Heavy wire mesh encloses the top and sides of the DB Resistor assembly to prevent accidental exposure to high temperature and high voltage present on the resistors. Figure 36 shows the overall size and mounting dimensions for the various DB Resistor types.



Power	L	B	H	A	D	E	F	b x l	Weight
400 W	450	60	85	430	30	404	23	5.5 x 9	2.6 kg
800 W	550	80	116	530	40	504	23	6.5 x 9	4.7 kg
1600 W	550	180	116	530	90	504	23	6.5 x 9	5.6 kg

Figure 36 Dynamic Braking Resistors Dimensions (all dimensions in mm)

Wiring Information

DB Resistors are supplied with a 3-meter long, shielded cable attached to it, and a connector kit for attaching to the SAM Supply plug. The SAM Supply end of the cable is left unterminated to facilitate routing the cable and to permit trimming to required length before installing the supply end connector. Trim the cable to the required length, then assemble the connector as follows:

1. Insert the cable gland components onto the cable as shown in Figure 18.
2. Fold the cable shield back over the cable gland inner plastic sleeve as shown in Figure 18.

There must be metallic contact between the cable shield and cable gland around the whole circumference of the shield. "Pigtails" degrade high frequency suppression considerably and are not permitted.

3. Install the cable gland, connector X2 and attaching screws into the bracket as shown in Figure 37.
4. Terminate the conductors in connector X2 using the wiring diagram in Figure 38.
5. Tighten the cable gland outer nut.
6. Plug the assembled cable into the mating connector X2 on the SAM Supply.

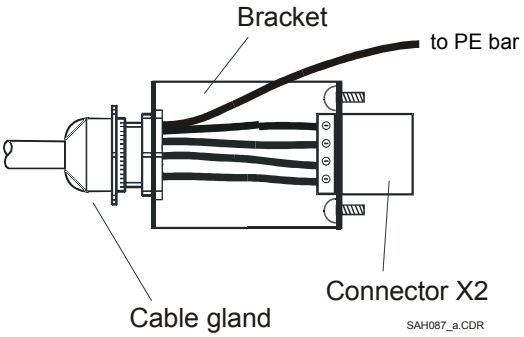


Figure 37 Dynamic Braking Resistor Cable Assembly

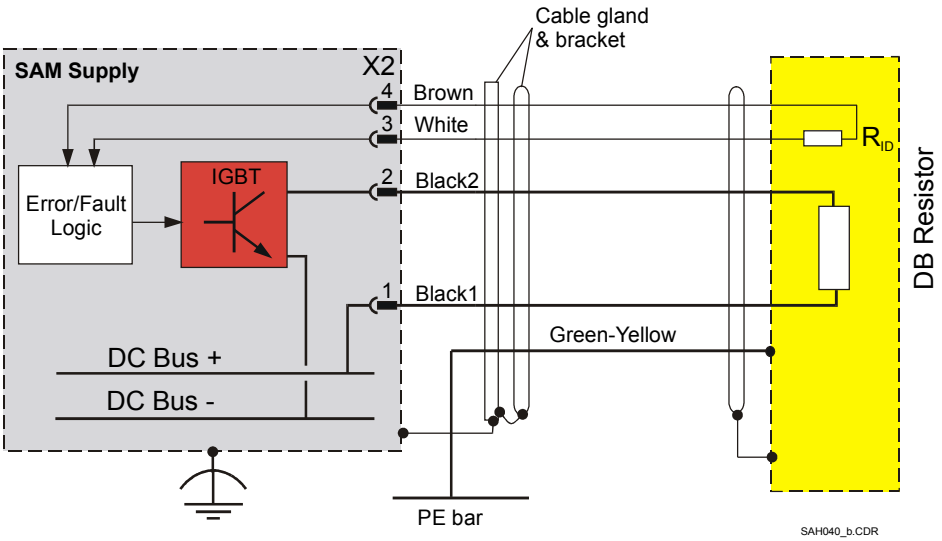


Figure 38 DB Resistor Circuit Wiring

Safety, Status and 24 VDC Supply

Status Outputs

The SAM Supply provides four (4) PLC compatible status/error outputs (see Figure 39) including:

- Dynamic Braking Resistor Overload
- Over Temperature
- Over Voltage
- DC Bus Low

They are normally monitored by a PC/PLC performing overall machine control. Figure 39 illustrates a typical circuit. The status outputs are isolated from the SAM Supply internal electronics and share a common connection to 24 VDC power. For a detailed description and electrical specifications of these status outputs, refer to Part 6 - “SAM Supply Technical Information”.

Fatal Error Output

Fatal Error is an isolated relay contact intended for use in implementing machine level safety interlocks. See Part 3 - “Safety and Protective Functions” for further information.

24 VDC Supply

The SAM Supply requires 24 VDC power for its internal operation. All required internal voltages are derived from the 24 VDC supply. Refer to Part 1 - “Selecting System Components” for 24 VDC power supply requirements.

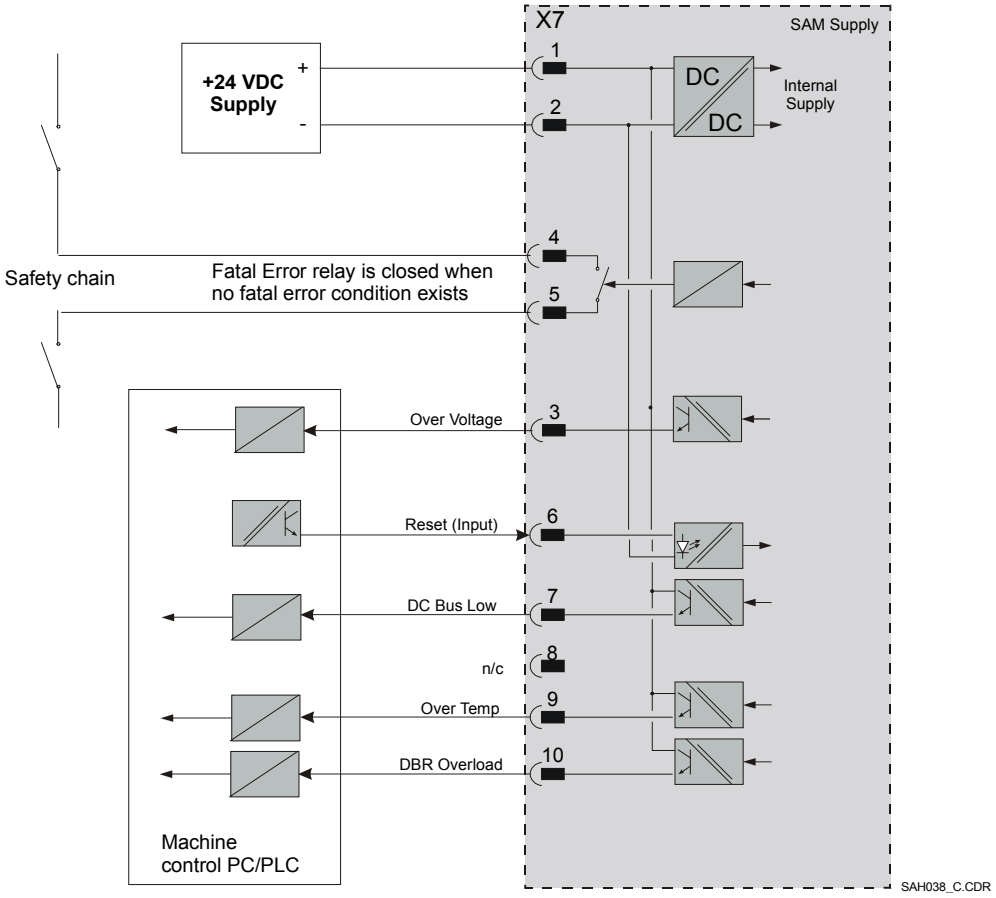


Figure 39 SAM Supply Status, Safety and 24 VDC Supply Connections

Connector Locations and Pin Assignments

PA-xxx-30x-x

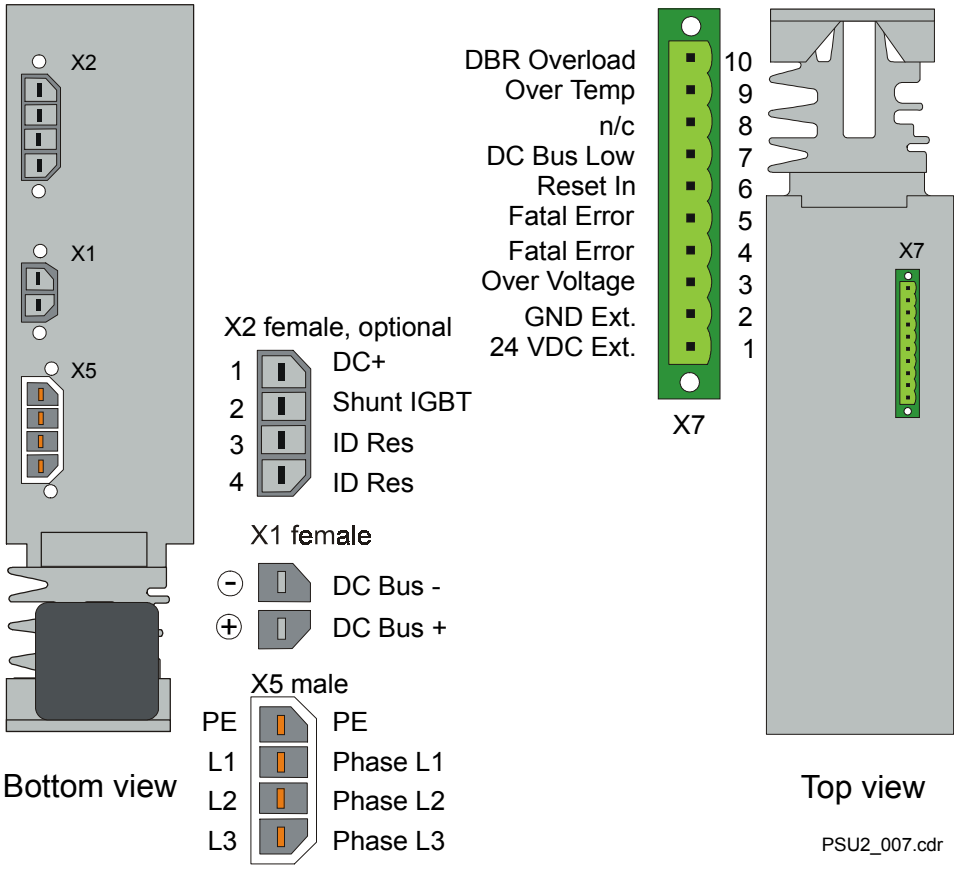


Figure 40 Connector Locations and Pin Assignments for 30 amp SAM Supply Models (X2 connector is available only on SAM-PA-xxx-30-E type)

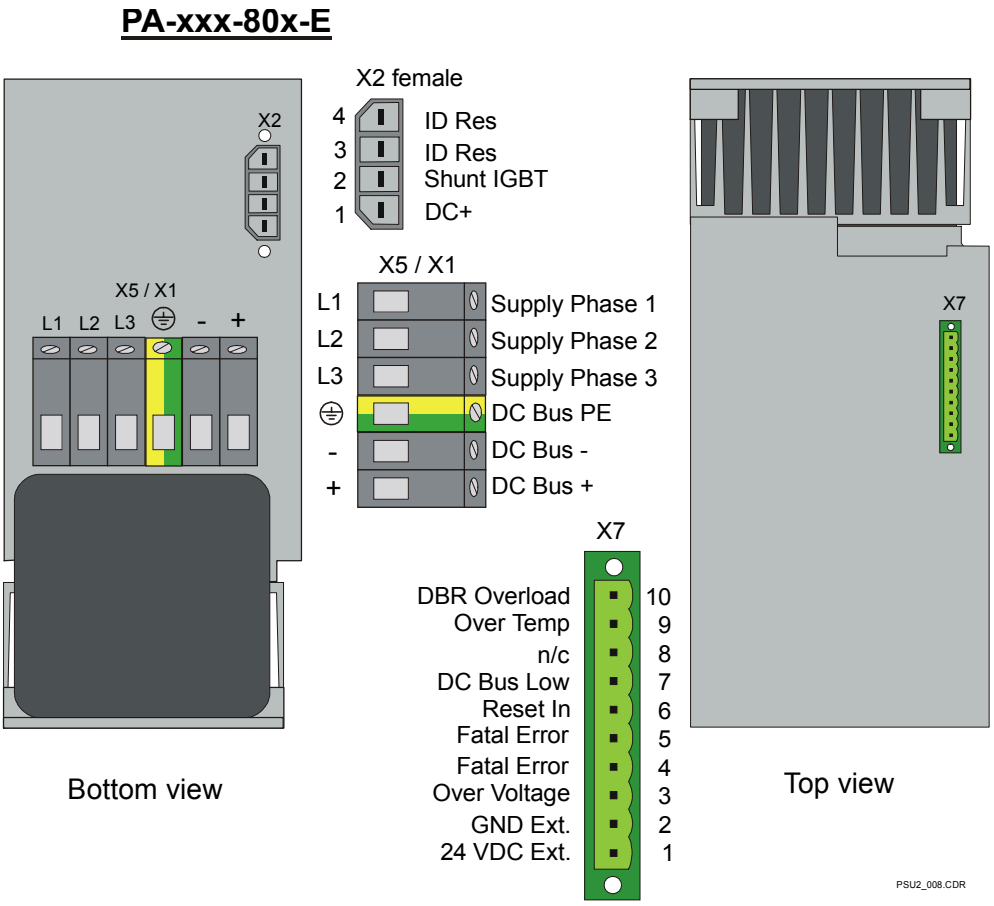


Figure 41 Connector Locations and Pin Assignments for 80 amp SAM Supply Models

DC Bus

General

The DC Bus distributes DC Power at high voltage and current levels from a SAM Supply to SAM Drives. The DC Bus voltage (DC Bus + to DC Bus –) can be as high as 800 VDC and the DC Bus must be totally isolated from ground. In systems with multiple SAM Supplies, the DC Bus for each SAM Supply must remain totally isolated from the DC Busses of all other SAM Supplies.

High DC Bus voltage ranging from 550 to 800 at high power level is present at the SAM Supply and on the DC Bus. This high voltage is stored in large capacitors, which retain the high voltage after the AC Supply is switched off. Wait 60 seconds after removing AC Supply before touching any component carrying DC Bus voltage.

DC Bus Bar Assembly

General

This paragraph provides installation and interfacing instructions for the PAM and SAM System Bus Bar assembly.

Installation

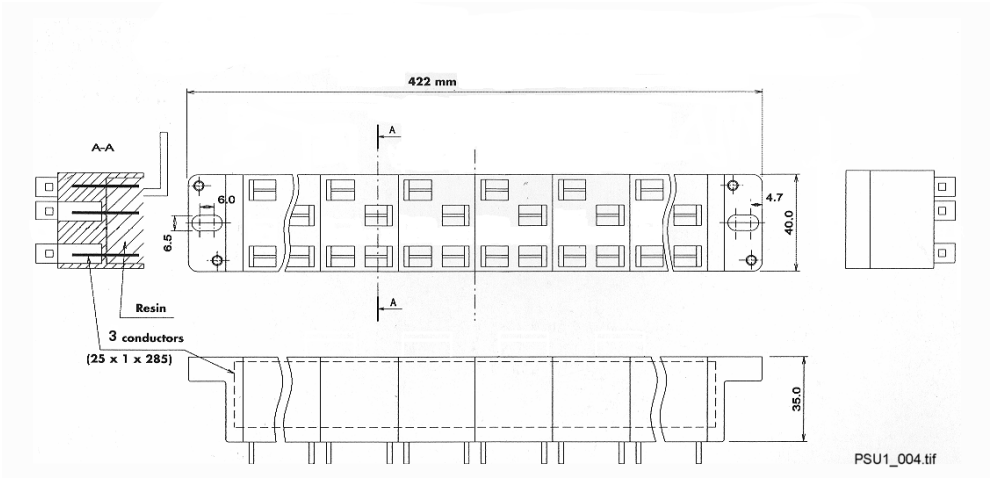


Figure 42 DC Bus bar outlines

Wiring

Figure 43 shows the wiring diagram for the DC Bus Bar assembly. Additional PE Ground nodes are provided on the DC Bus Bar assembly for the PE ground conductors of motor winding cables.

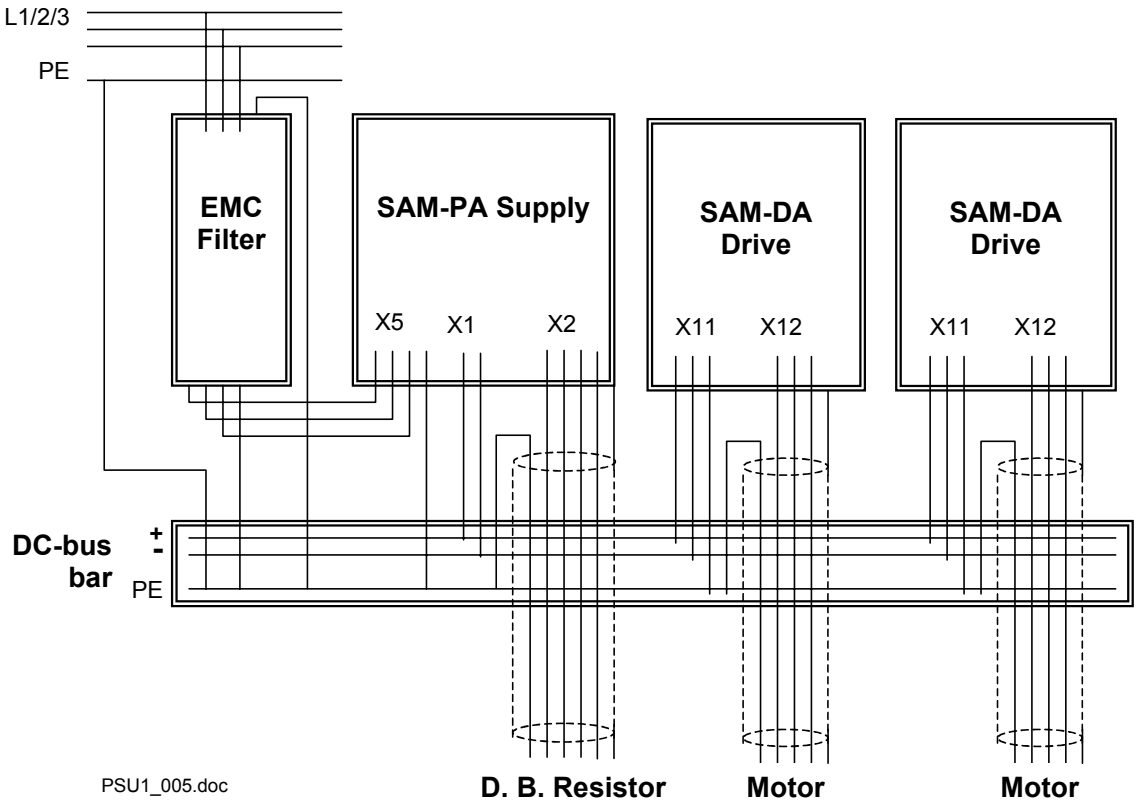


Figure 43 Wiring Diagram for DC Bus Bar Assembly

DC Bus Bar plugs are not keyed. It is physically possible to insert any plug into any connector. The user must verify by inspection that all connections to the DC Bus Bar are correct before applying power to the SAM Supply.

Low Power Applications

For small systems (i.e. a PA-…-30-… and 1 to 3 SAM Drives) a simple DC Bus can be constructed using daisy chained wiring from the SAM Supply to SAM Drives in combination with a simple earth ground rail. The PE rail can be a simple Copper bar; it does not have to be IP20 protected, as it is solidly at earth potential. Figure 44 illustrates the circuit schematically.

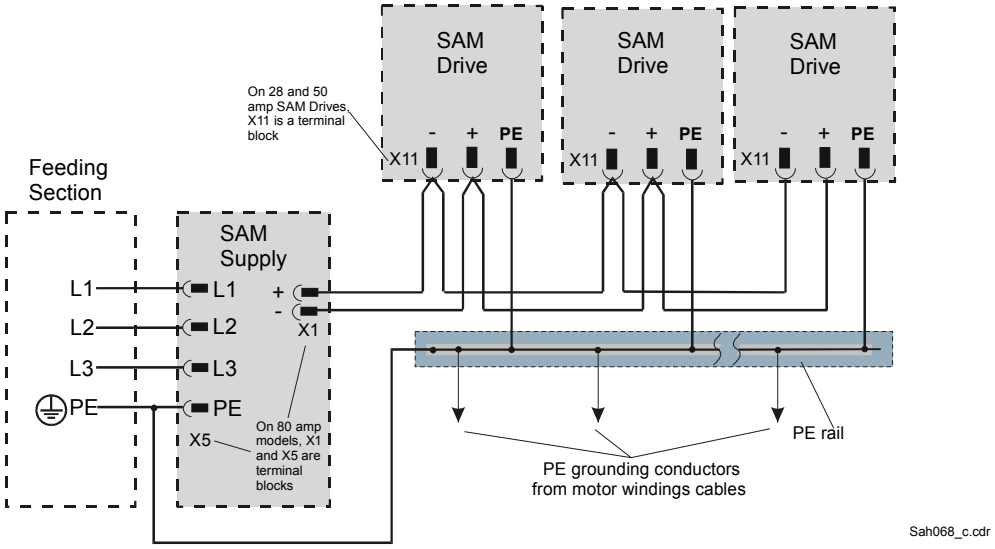


Figure 44 DC Bus Arrangement for Small Systems

Feeding Section

Basic Circuit

The Feeding Section includes all components of the AC Supply circuit between the AC Supply and the SAM Supply. Refer to Part 1 - “Selecting System Components” and to Part 3 - “Safety and Protective Functions” for details on sizing and selecting Feeding Section components.

The AC Supply to a PAM with SAM system must have a grounded neutral. Operating a PAM with SAM system from an ungrounded AC Supply is prohibited.

Installing an EMC Line Filter

When installing an EMC filter, refer to Rules for Placement of EMC Line Filter on page 14. The connection method for making load and line side connections is via wire leads or terminal blocks depending on the model. Table 1 lists the connection method and conductor cross section for each model. Refer to Figure 45 for EMC filter dimensions.

The EMC filter relies on capacitance between AC Supply conductors and functional earth. Therefore, the EMC line filter must have metal to metal contact with the ground plane (back panel) over the largest possible area.

If a Ground Fault Interrupter is used in the Feeding Section, The leakage current for each EMC filter must be taken into account (see Table 1).

p/n	model	current rating @ 40°C (50°C)	leakage current	Line side connections	Load side connections
9032 011 149	FN 258-30/07	36 (30) A_{RMS}	104 mA	Terminals 1 - 10 mm^2	Wires AWG 10 5.37 mm^2
9032 011 150	FN 258-75/34	90 (75) A_{RMS}	113 mA	Terminals 10 - 25 mm^2	Terminals 10 - 25 mm^2

Table 1 EMC Filter Information

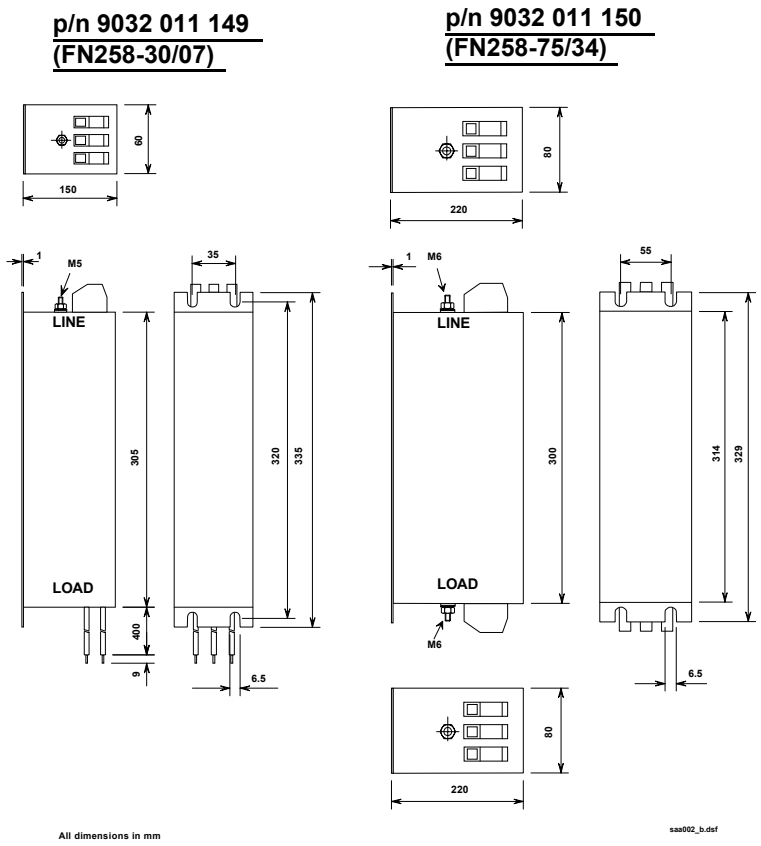


Figure 45 EMC Filter Dimensions

Interfacing a Transformer

When a Transformer is Required

A transformer is required under any of the following circumstances:

- The AC Supply voltage exceeds the maximum rated voltage that may be applied to a PAM with SAM system (see Part 1 - “Selecting System Components”).
- The AC Supply is not a three phase, four wire system with grounded neutral (see AC Supply with Grounded Neutral on page 8).

Operating a PAM with SAM system from an ungrounded AC Supply is prohibited.

Interfacing an Isolation Transformer

Figure 46 illustrates the wiring of isolation transformers. The transformer secondary (load side) must be wired in a "wye" configuration and the star point, which is the secondary's neutral, must be solidly grounded with a low-impedance connection to protective earth ground. The primary may be either “Delta” or “Wye” connected.

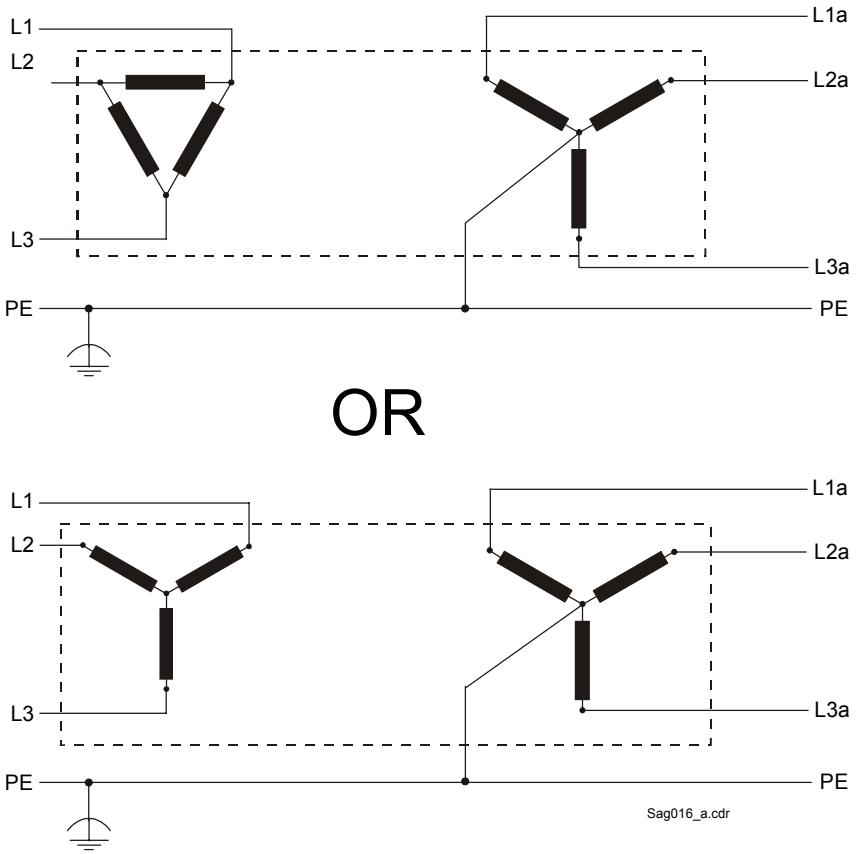


Figure 46 Isolation Transformer Configurations

Interfacing an Auto-transformer

Auto-transformers are always “Wye” connected; their star point must be solidly grounded with a low impedance connection to protective earth ground as illustrated in Figure 47.

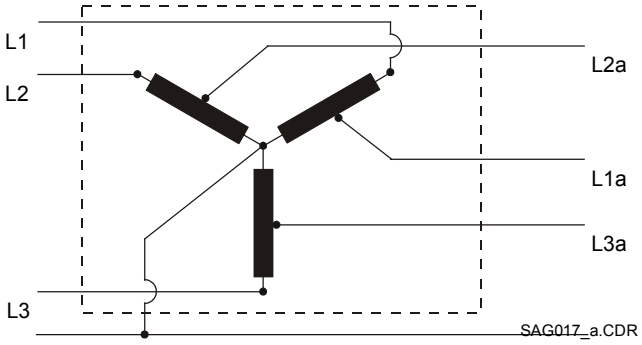


Figure 47 Auto-transformation Wiring Configuration

24 VDC Supply

Functions

The 24 VDC supply provides a low voltage power source which each SAM Drive, SAM Supply and PAM (Full system only) utilizes to develop their internal operating voltages. On units equipped with cooling fans, the fans are powered by 24 VDC. The 24 VDC supply may also be utilized as a power source for:

- Operating electro-mechanical brakes on motors
- Devices controlled by the User I/O on a SAM Drive
- Other system or machine functions

24 VDC Power Distribution

General System Diagram

Figure 48 is a general system level diagram illustrating distribution of 24 VDC power in a PAM with SAM system. Refer to the relevant sections of this chapter for detailed information on interfacing to the PAM, SAM Supply and SAM Drive.

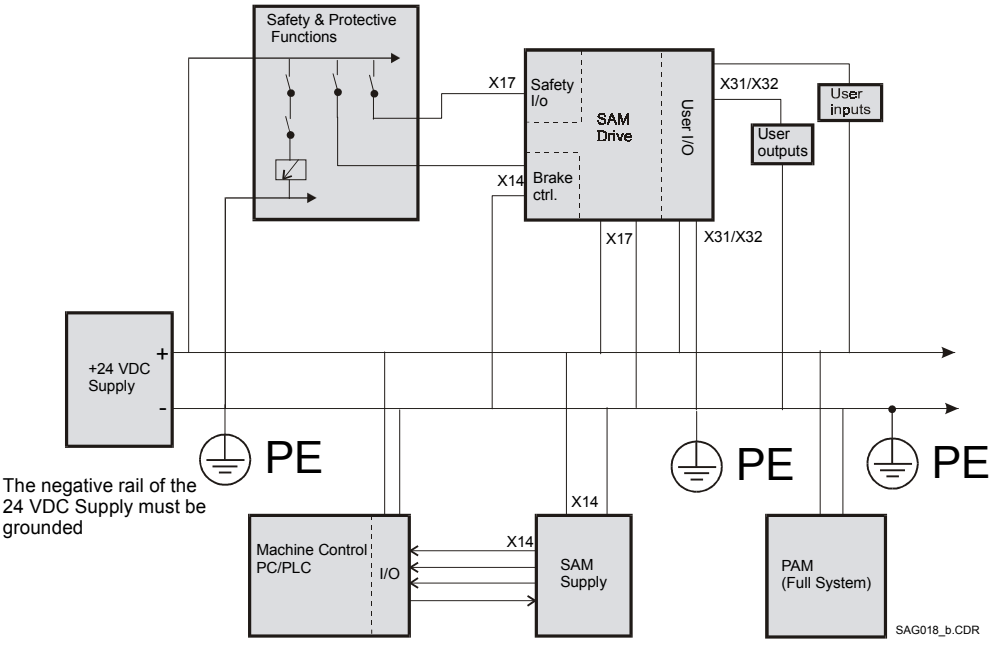


Figure 48 24 VDC Power Distribution

ACC recommends not removing 24 VDC power during or immediately following a controlled or uncontrolled machine stop because valuable diagnostic information retained by the PAM, Sam Drive and SAM Supply is lost with the removal of 24 VDC power.